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OF THE 1972 CLINIC  
ON LIBRARY APPLICATIONS  
OF DATA PROCESSING**

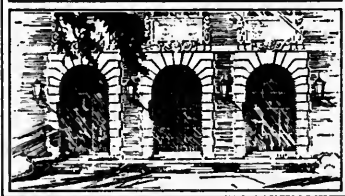
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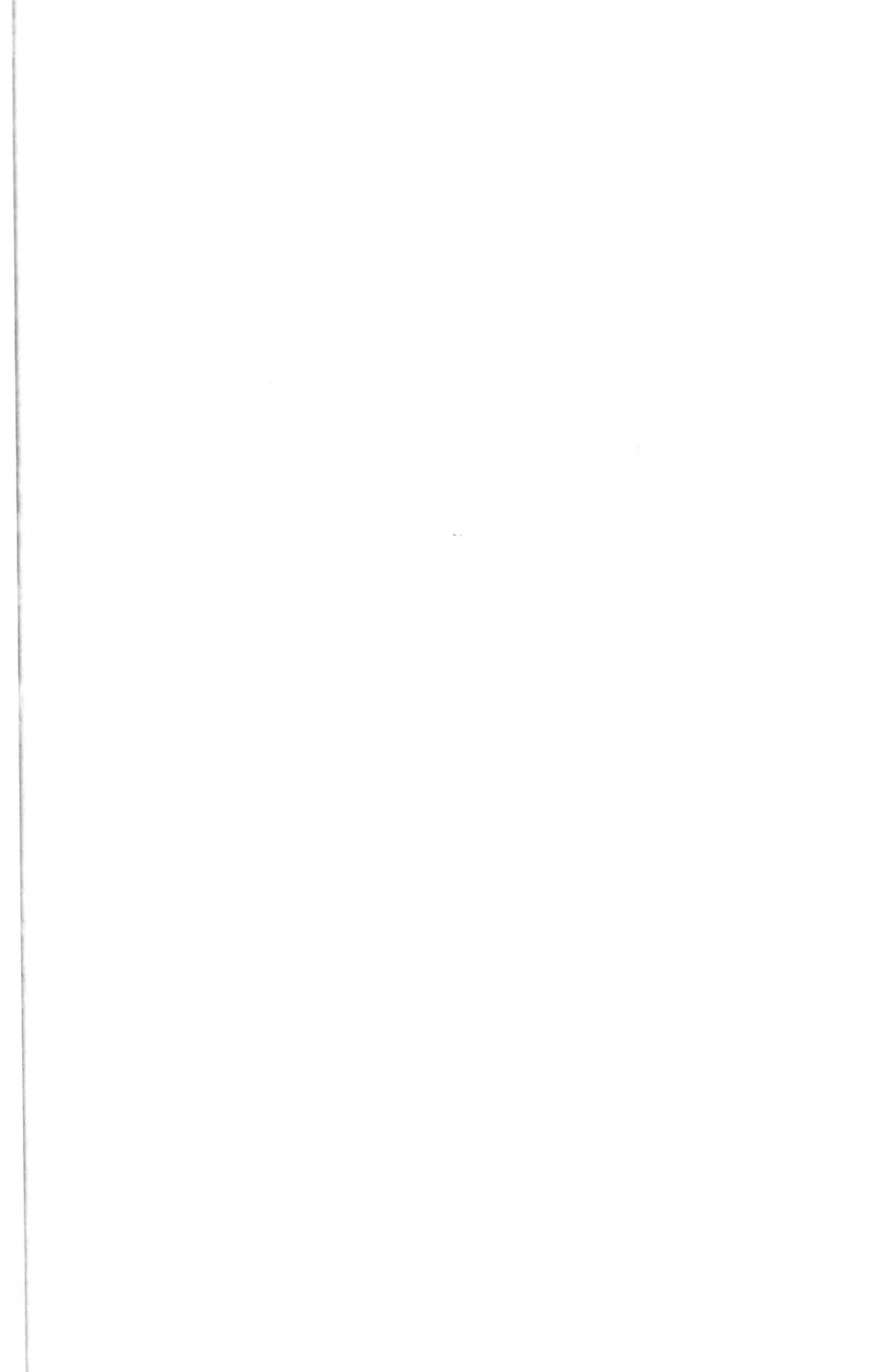
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**Proceedings of the 1972 Clinic  
on Library Applications  
of Data Processing:  
Application of On-Line Computers  
to Library Problems**



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ON LIBRARY APPLICATIONS  
OF DATA PROCESSING:  
APPLICATIONS OF ON-LINE COMPUTERS  
TO LIBRARY PROBLEMS**

**Edited by  
F. WILFRID LANCASTER**

**Papers Presented at the  
1972 Clinic on Library Applications  
of Data Processing, April 30–May 3, 1972**

**University of Illinois  
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## INTRODUCTION

The ninth annual Clinic on Library Applications of Data Processing was conducted by the Division of University Extension and the Graduate School of Library Science of the University of Illinois, on April 30-May 3, 1972. Like the eighth clinic, it was devoted to a single topic: the application of on-line computer systems to the mechanization of library operations. Significant advances have been made in this field in the last three or four years and a number of interesting and innovative systems have become operational in some relatively small institutions as well as the very large library organizations.

In planning this clinic an attempt was made to include papers on a wide range of library applications of on-line computers, as well as to include libraries of various types and various sizes. Two papers deal with on-line circulation control (the Ohio State University system, described by Hugh C. Atkinson, and the Northwestern University system, described by Joseph T. Paulukonis), one with acquisitions (LOLITA at Oregon State University Library, described by Larry Auld and Robert Baker), one with serials control (a system at the Biomedical Library, UCLA, described by James Fayollat) and one with on-line cataloging procedures (used in the Shawnee Mission Public Schools and described by Ellen Miller and B. J. Hodges). Multi-functional on-line systems are represented by the BALLOTS project at Stanford University (described by A. H. Epstein and Allen B. Veaner). I. A. Warheit of IBM gives a comprehensive overview of the application of on-line interactive systems in libraries. Irwin Pizer describes the use of such systems in library

networks, and Glyn T. Evans undertakes the difficult task of identifying and summarizing key points made by previous speakers.

Ellsworth Mason, to use his own words, plays the role of Daniel in the lions' den and plays it in his own able and inimitable way. His talk drew a crowd that probably set a record for attendance at a session in this series of clinics. The talk was entertaining as well as provocative and it generated many questions, which were ably handled by the speaker. Some hostility toward the speaker was evident in certain segments of the audience!

I am very grateful to all of the speakers whose work appears in this volume and whose excellent presentations made this a very successful meeting. Grateful acknowledgements must also be made to my colleagues on the planning committee: Herbert Goldhor, Director of the Graduate School of Library Science, and J. Divilbiss, Associate Professor, Graduate School of Library Science, University of Illinois. To the latter in particular must go full credit for the planning and implementation of the on-line demonstrations that were an important feature of this ninth Clinic.

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## On-Line Interactive Systems in Libraries, Now and in the Future

For the sake of clarity one can discuss on-line interactive systems with reference to their technology, their economics, and their application and utilization, even though all these aspects are obviously intertwined and inseparable. They will, however, be considered separately.

On-line, interactive systems were conceived long ago, even before computers. Vannevar Bush's Memex was essentially an on-line interactive system, as were the first teaching machines. What is considered the first computer-based interactive systems were implemented by M. I. T. in its SAGE system which responded to RADAR signals. From a practical, economically feasible point of view, however, certain technological developments were necessary before on-line processing could be widely adopted.<sup>1</sup>

### TECHNOLOGY

The first computers were serial devices with all information stored on tape. Access to a record involved passing a reel of tape and serially searching the records. Although information could be stored on drums and thus provide very rapid access to records, the capacities of drums were so low and drum storage was so expensive that their use was confined almost entirely to program information, tables, etc. The file of records, except for a few exotic and expensive applications, was not stored on drums.

The only practical, economic storage, therefore, was on tape, and processing, for the most part, had to operate in a batch mode. In the

mid-1950s the RAMAC, the first disk file, was announced. With RAMAC it was possible to access a record directly without having to search serially a whole file. With the disk, there is actually a serial search of a track, but this is so short that for all practical purposes one can speak of direct access to a record. With the disk file, the computer in a sense graduated from the age of the scroll to the age of the leaved book or card file.

With the availability of disks, it became feasible for man to communicate directly with the computer. Where previously most communication with the computer was via the punched card or the punched paper tape, now a number of terminals, primarily typewriter and teletype keyboards, were developed or adapted to communicate with the computer. These terminals, which were a great convenience, because now the computer inputs could be prepared where the data originated, were used for remote job entry and to order printouts from the files. Competing devices, primarily key-to-tape recorders and optical scanners were more economical than the terminals however, and so direct remote job entry for information collection did not find very wide acceptance.

The use of on-line terminals has been popular for text editing which was developed in the early 1960s, especially for those applications that required frequent, rapid and radical changes in text. Even here, the development of such machines as the magnetic tape Selectric typewriter (MT/ST) provided a number of text editing capabilities at such a low cost that many users, and especially libraries—including the Library of Congress—found the MT/ST a very satisfactory and economical device to create records and edit text for computer storage.

Although other devices have been less expensive than on-line terminals for remote job entry and for limited text editing, they have been preferred where large amounts of text must be handled or where complicated text editing is required.<sup>2</sup> For example, when an intellectual activity has to be supported such as doing calculations for the engineer, scientist, statistician, accountant, etc., or a proper entry must be chosen to fulfill an order or make a flight reservation, on-line processing is again the most preferred method. It saves much human labor, increases and speeds up the throughput, and, in many instances, improves the precision to such an extent that commercially competitive industries and professions are adopting on-line methods wherever it is advantageous.

With the development of direct access storage devices (DASD), it became feasible to communicate with the computer in real time. The user could interrogate the files to get an instant response. If the amount of information that was transmitted and displayed was not extensive, then the voice grade telephone lines and the 15-characters-per-second typewriter terminals were adequate. Where, however, the number of characters to be displayed exceeded 200 to 300, then the user became impatient since he could read much faster

than the terminal could type. The display terminal, built around the cathode ray tube (CRT), has therefore become very popular; it can display 500 to 1,000 and more characters instantaneously, and is proving to be, in its basic form at least, inexpensive to manufacture and operate, and hence very competitive with the typewriter terminals.

One major objection librarians have had to the display terminal is that the more available, low cost display units have had limited character sets, and have not provided the upper and lower case and special characters that librarians want. Extended character sets are available with display terminals but they are relatively expensive. It actually does not cost much more to manufacture a terminal with an extended character set; the market has not yet justified the large-scale manufacture of such terminals. As the market develops, especially in the so-called media industries—advertising, printing, etc.—large-scale manufacturing will bring down the cost of extended character set terminals, and the librarians will get the terminals they need at a price that they can afford.

There are other aspects associated with terminals of interest to librarians. The so-called intelligent terminals that permit a certain amount of processing by providing access to special local files, and the buffered terminals that will hold working amounts of inputs and outputs, represent special approaches to develop the most economic configurations for a variety of applications. In other words, the terminals that will be used will range from the so-called dumb ones, like the touch tone telephone, to the intelligent ones which are essentially small computers.

The use of terminals initiated the need for communication links. Although many data processing people were apprehensive that the communications industry would become a major bottleneck for data processing, this has not proved to be the case. Attempts are currently being made to reduce communication costs, and there is every indication that they will succeed. Hardware, in fact, is probably the smallest obstacle to the development of interactive library systems.

Even the software problems which affect library automation and also affect batch systems, actually present no real hindrances. The main problem for library automation is the organization and handling of a variety of very large files. In addition, library bibliographic files are somewhat different from the more usual commercial and name (so-called people) files. Library records are long; the average MARC record is of the order of 600 bytes<sup>3</sup> to which has to be added the local library's data including costs, holdings, etc. There are many records. There are 16 million records in a National Union Catalog, and, the Library of Congress needs a trillion bit file to store such a file.<sup>4</sup> Although such files exist and are being used very successfully, they are slow and hence not well adapted for interactive processing. In a typical situation, it now takes about five seconds—an intolerable length of time for a computer—to get the

first record. Actually this is not very bad since by use of lookahead, overlap, buffering and taking advantage of the slowness of the human, the getting of subsequent records is faster and does not necessarily hold up processing.

The lessened reliance on physical movement and the greater reliance on electronic switching is so speeding up the accessing of magnetic records that fetching a record will not be the bottleneck it has been. There is also the exciting potential of holographic memories, but that is farther in the future. Massive storage devices and digital communications are being improved very rapidly. In an industry which has had a rapid technological growth, these two areas are currently having the most rapid growth and development.

Computer designers are very much concerned with the balance between the various working parts of a system. For example, getting the input/output (I/O) functions in balance with the internal processing can be a problem. Wherever this type of physical bottleneck develops, one can be sure that a great deal of effort will be devoted by manufacturers and data processing personnel to solving the problem. Putting together the physical components of a system is not the job for an amateur. There have been several computer configurations assembled by library systems people on their own which have left a lot to be desired.

With the coming of time sharing, the most difficult problem was what data processing personnel call resource allocation or resource management. This also involves communications control, i.e., controlling the traffic generated by a number of different users, each doing different tasks from different terminals. As a result, operating systems and supervisors or monitors began to be developed. Since different users accessed a number of different files and there was a growing desire to separate application programs from data base management, major efforts were devoted to building independent data management systems. These developments all represent a currently strong movement towards making application programs independent of the host. For library interactive systems, data base/data communications (DB/DC) systems are needed that will work efficiently in a conversational mode and on unformatted, variable length records. Such programs are currently being developed using a number of different approaches; as a result there is some confusion and chaos. Standard, supported programs are however now available and users do not have to compromise or make do with supervisors and monitors that are barely adequate or prohibitively expensive.<sup>5</sup>

With on-line processing, data base integrity becomes very critical. Where there is updating in place, the files have no old master on which one can fall back in case of failure. The file, therefore, must be protected while processing goes on in core. Input from a terminal cannot be held to the quality standards normally expected from keypunch. There are no verify operations from the terminal and bad input data can damage the data base. If the originator inputs the data and scans it on the display terminal before storing it, the inputs are



usually of very high quality. Nevertheless there is a great need for very good editing and input validation. Data bases also have to be protected from faulty application programs which can occur when existing programs are modified.

For all the above and a number of other security reasons, it is extremely important to have powerful DB/DC systems. The development of such programs is a highly specialized task. One must caution library systems personnel against preparing homemade, special DB/DC programs. This is an expensive waste of time which really does not aid the library, even though it may satisfy the ego of the system designer. Essentially, what I am trying to emphasize is that library people should not try to act as engineers or programmer specialists building type 1 programs, but should devote their time to application programs and problems that are peculiar to libraries.

One could go on to analyze a number of different aspects of data base management, data communication, and operating systems, but these are really not any impediment to the adoption and utilization of interactive library systems. There are a number of fairly satisfactory software programs for all of these problems and a large number of people are working on improving or replacing these programs with better systems.

File and index organization is much more specialized and pertinent to the success of library programs than the DB/DC programs. Although computer professionals and the computer industry are devoting an appreciable effort to the organizing and accessing of large files, they often overlook or ignore the special problems of library files. Library files are different and are used differently from the more usual data bases found in business, industry and science. Librarians and the library systems personnel must, therefore, devote some thought and effort to the organization of their files.

Librarians are beginning to appreciate the economics of book storage where little-used materials are kept in less accessible but more economical storage facilities. However the cost of retrieving and returning the book from such storage is high compared to that of retrieving the more frequently used materials which are kept in the most expensive storage area close to the library user.

However, the librarian is reluctant to organize all his records similarly, feeling that the information seeker will not understand and hence will be less tolerant of impediments and delays in finding information. Once having found the books he wants, the library patron is more apt to be tolerant about the delivery of the older, more exotic and hence less accessible items. Much of the present effort in the data processing community is to organize files based on usage patterns. Although the librarian may accept this concept for his materials, he is less apt to accept this for his subjects and authors. He therefore has no hesitancy about putting in separate storage certain information such as the data associated with ordering and receiving an item—vendor, cost and the like—which he knows he will hardly ever use after the

transactions are completed. However, subject and author information, even though it may be associated with little-used materials, may be consulted urgently and frequently both by library patrons seeking information and librarians using the records as authorities for processing new acquisitions. Data processing people as a rule do not fully appreciate this and do not really understand why the file organization developed for, let us say, a large insurance company is not ideally suited for a file of library records of a similar size.

The index organization of the more heavily posted areas—the Bible, Shakespeare, the U. S. Government—also present special problems. In the past when using manual files, reliance has been on human discrimination in wading through these interminable indexes. Librarians have ignored this problem partially because they had no way of knowing how people used such indexes. Now with computer systems having statistical modules, librarians will be better able to know how people use the catalogs and other finding tools and hence will be in a better position to do something about catalog organization.

At this point data processing is just beginning to attack the whole problem of subject cataloging and indexing. Most library data processing systems, certainly those in academic and public libraries, are merely accepting the subject organization which has traditionally been used in library catalogs. There are only a very few systems that not only allow for several levels of subject indexing but also for completely different vocabularies. There are many difficulties in accomplishing this, an example is the National Library of Medicine's problems trying to interface the MeSH headings for pharmaceutical and organic compounds with the much larger and more specific vocabularies used by *Chemical Abstracts* and the Food and Drug Administration.

Even with the dual vocabularies—detailed descriptors as well as standard library subject headings—that we used in the library management system installed in the library of the IBM Advanced Systems Development Division, Los Gatos Laboratory, and even though full file review is available for all access points and Boolean operators can be used in searching the descriptor indexes, and permutation is applied to titles and corporate authors, still the research personnel are not fully satisfied with the searching capabilities of the system. They want the full panoply of Boolean operators extended not only to full subject headings, but also the masking and permutation capabilities extended to the subject headings so that the individual elements making up a subject heading can be searched like descriptors. Then the system will help them make hierarchical searches, provide automatic cross reference control, etc.

But this is a large area needing specific discussion and is not specifically associated with on-line interactive systems. What is important for interactive systems is that no matter what type of indexing or labeling used and no matter what search strategies employed, there are going to be some heavily

posted items which will be time-consuming to access, no matter how fast the hardware might be. Some thought must therefore be given to the design of accessing or addressing methods to overcome, or at least mitigate, this difficulty. Probably some form of a hierarchical index sequential method as presently applied in one library on-line system will have to be employed.

Of more immediate consequence and promising greater benefits for organizing the main bibliographic records is the file organization used in the Los Gatos Library management system mentioned above.<sup>6</sup> Although all library records of an item were combined into a single logical record, the physical storage and display of the record was segmented into separate physical parts. The system designers decided to establish a hierarchy of physical storage since only a small part of the record—author, title, publisher, date, physical location and availability—was used for finding purposes; and the rest of the stored information, both bibliographic and commercial, was rarely used, and then primarily for processing purposes. In normal searching of the files, only a two-line record was displayed and the normal terminal could display up to four such records simultaneously; if the total record of an item were desired, then the rest of the record was fetched from a lower storage and only a single record was displayed, usually filling the whole screen. At Los Gatos, it is strongly suspected that not only is this more efficient for storage and machine processing, but it increases the possibility that the use of the catalog record as a means of finding information will succeed. The library catalog, after all, is built for two purposes: one as a control of the collection and the other as a finding tool. Too often the control functions complicate or at least obscure the purely identifying and finding elements of the catalog record and hence make the library catalog difficult to use, especially for the public.

Once it is recognized that the usage patterns of library files is different from the more usual files used in other applications, one can make more intelligent decisions about organizing the records. For example, in most situations where a trade-off between processing and storage is possible, it is more economical and more efficient to save processing time at the expense of storage costs. Library usage seems to dictate just the opposite. With only very tiny segments of the file accessed at any one time and with very large parts of the file used extremely infrequently, it is more economical and basically more efficient to conserve storage space as much as possible even at the expense of increased processing costs. This may involve the extensive use of pointers and codes and tables to compress records and avoid redundancies, or the physical segmenting of records to avoid transporting more than is necessary.

Many of the problems described are still anticipatory. Except for the rising quantity of MARC records—which few libraries are really prepared to store—librarians do not yet have very large files, nor do they make heavy demands on them. It is going to be a while before the National Union Catalog is stored in the computer or before all of *Chemical Abstracts* is available in

digital form. In the meantime, technology is not going to stand still. It seems rather pointless for the librarian to spend time worrying about solving tomorrow's problems with today's tools, especially when he is not sure what tomorrow's problems will be.

This all means that essentially there are no serious technological difficulties which hinder the development of on-line, interactive library systems. There is an awareness that, as interactive systems develop and as people learn how they work and what their potentialities are, systems will grow and change and library processing and library usage will change. Nevertheless there is a good understanding of what needs to be done now to get started, become operational, and to do today's jobs. It means that efforts should be expended to produce application programs and operate them not only to do productive work but also to explore the improvements that can be made. To quote from the report *Libraries and Information Technology*, of the National Academy of Sciences to the Council on Library Resources, "the primary bar to development of national computer-based library and information systems is no longer basically a technology-feasibility problem. Rather it is the combination of complex institutional and organizational human-related problems and the inadequate economic/value system associated with these activities. National leadership to solve these problems has not emerged."<sup>7</sup>

## ECONOMICS

The "inadequate economic/value system" that the National Academy of Sciences considered "the primary bar to development of national computer-based library and information systems" encompasses the totality which they call the "economics of information." The economic justification of information in general and libraries in particular goes far beyond the purview of this article which assumes that data processing has been accepted or at least is being considered for adoption in libraries. However, a number of interactive systems are being looked at and evaluations are being made about the utility and value of on-line interactive systems.

An on-line system requires a communications link, a terminal, storage for its records in a more expensive device than a reel of tape, and controls for the flow of messages which makes it more expensive than an equivalent batch system. The basic question is therefore, "Is it worthwhile to have an on-line system?" The answer is, "Only if the total on-line operation is more economical, and/or if it provides added services such as producing a better product, or doing things more quickly." One should not minimize the convenience factor. People are willing to pay a great deal for things which minimize work, save time and in general increase throughput. But basically, for an on-line system to have wider use in the library, it must be more economical than a batch system.

The hardware and software of an on-line system cost more than a batch system. Ultimately the difference will not be as great as it is at present, since a good on-line system does not require the large and expensive support mechanism that all manual and batch systems require. These include card files, printed lists and directories, guidebooks and other masses of printed paper. A good on-line system can be truly paperless, and the maintenance of paper in the library—that is the working paper and not the bibliographic collection—is an extremely expensive business. It is reported that the Library of Congress maintains over 1,200 files. It is quite conceivable, although this has not been worked out as yet, that the larger displaceable costs of an on-line system will make it competitive with a batch system. Currently, for example, an on-line circulation control system in a large library can be cheaper than a batch system because of the elimination of the massive printouts of circulation lists.

What is incontrovertible is that the on-line system saves labor compared to the usual batch and manual system. At the lowest level, just bringing the needed information to the worker rather than having the worker physically go and get it can be a very important laborsaver. Studies at the Library of Congress have shown that 60 percent of a cataloger's time is spent walking from his desk to the various files and catalogs, opening the trays or bound volumes, transcribing the information and carrying it back to his desk.<sup>8</sup>

Repeated copying of information is another wasteful operation. At the National Library of Medicine analysts select and index the journal articles and prepare worksheets for the keypunch operators. These clerks transcribe the worksheets and prepare machinable inputs. When the information flows into the computer it is edited and the detected errors, whether originally committed by the indexer or introduced by the transcription clerk, are detected and the record is recycled, usually all the way back to the indexer.<sup>9</sup>

Recycling costs are very high. Even with the MARC program and its use of the MT/ST, which has reduced the error factor at the Library of Congress and has speeded up cataloging, the amount of recycling is still very high and most of this is due to error detection in machine editing and proofreading. On the average it takes three inputs to produce two records at the Library of Congress. Where editing and proofreading are done on-line, the original material is still in hand, and the decisions are still fresh in the librarian's mind, and there is no intervening clerk to introduce additional errors, the amount of labor required is greatly reduced and the time needed for the preparation of the record is shortened.

Similarly an on-line circulation control system can be a laborsaver. Since each transaction in an on-line circulation control system is essentially an inquiry to validate the legitimacy of the transaction and since all the elements involved in the transaction are present—the borrower, the book and the librarian—the snags and conflicts can be readily resolved. In a batch system, the snags show up long after the transaction has been completed and the

loan has been made. To resolve the problem at that time is often a long and tedious business. In one university library, the on-line circulation control system made it possible to reduce the library's circulation staff from ten to five and even the remaining five had more time to provide other reader services.

There is one area where on-line systems can add to labor costs. A good on-line system forces the librarian to validate variable information. For example, when order librarians order a book, the system forces them to check the author and title even though in their own mind they are positive that the author and title are not in the library's records. The system also forces them to look at the completed order to be sure that everything is correct. Some are so confident, and some library's operations are so uncomplicated or at such a low level that such safety controls may be unnecessary and a hindrance to rapid and efficient processing. Some small systems, therefore, dispense with such controls. However, such safety controls are worth their cost, especially in large systems, even though the number of errors caught may be very small.

Since machine costs are decreasing rapidly and consistently and labor costs are rising rapidly and consistently, savings are ultimately going to be made with the system that will save labor even with an added machine cost.<sup>10</sup> In one study of a university library, it was shown that the projected rising labor costs, which included salary rates and increased processing requirements, would provide the necessary displaceable costs for a total library on-line system within five years. The costs of the system were set at today's costs and today's efficiencies. There was no consideration of any potential improvement in the system or the lowering of machine costs. In this instance, although there would be added costs for a number of years, the total system costs of the on-line system would in five years be less than the projected current system.

One can speak blithely of future costs, but the credibility of such figures seems to rest mainly not on any empirical evidence but rather on the basic attitudes of the individuals concerned. A few basic points should be made to support the contention that the developing on-line, interactive systems will be cheaper per operation while manual and machine batch systems will be more expensive.

One argument has already been made: that labor costs are rising steadily. In libraries they are rising at the rate of 10 percent per year. Data processing machine costs are dropping. Typical of any new technology that is past recouping the initial development costs, the cost decreases have been spectacular and will undoubtedly slow up in time. The rising operating costs are posing a real threat to libraries, for society is beginning to show signs of unwillingness to support libraries. When properly applied, machine systems can effectively perform many of the library's tasks and perform them more cheaply.

A few examples will be given of what is meant by "properly applied." There is a learning curve when a new system is installed. Once a new system becomes operational, one learns not only how to improve the system but how to improve one's skill in using it. Typically, in one interactive library system the operators could chain commands and institute default operations. The order librarian wants to examine an author entry to determine the correctness of the order information. The step-by-step procedure would be to first select the function to be performed, in this case, file review. From the file review list the index to be reviewed will be selected. In this case it is the author list. From this list the segment that contains the author's name will be examined. All this would involve a minimum of four steps with three displays. The first three steps can be eliminated along with two of the displays simply by chaining the commands which would bring forth the last two displays. Skillful experienced order librarians can chain a dozen or more commands—each command is a single letter or digit and involves only one keystroke; three or four commands can be routinely chained.

In addition to this command chaining, the operator can accept "by default" prestored information. For example, all the standard data stored in the file of the selected vendor can be accepted. Normal orders are, for example, put on an open or blanket order; ship best way; payment will be made in dollars upon receipt of invoice; and first claims are made in six weeks. None of this need be keyed in with the individual order since it is prerecorded in the vendor file.<sup>11</sup> The skill in using command chaining and default options depends on the experience and the ingenuity of the operator. The novice will have to proceed step by step. The experienced, clever librarian will be able to ignore and skip many operational steps and thus produce more with less work.

Systems also become more efficient as they become more integrated. Operating integrated systems should really be considered as experimental since they have not been applied as yet to the total system for which they have been designed. However, based on experience with such an experimental integrated system, certain conclusions are obvious. A single record can be put to a number of uses and produce a variety of products. The information keyed in to order a book is later used without additional keying by the cataloger to prepare the catalog record, and from that is produced the pocket and spine labels and the circulation card. It is this multiple use of a single input which can make the difference between a profitable and an unprofitable system.

Integration and multiple use of single inputs is possible not only with on-line systems but, to a certain degree, with batch systems. Actually, transferring a record from application to application in a batch operation, especially when the file is stored on tape and is accessible only in a serial mode, is so clumsy, expensive and impractical that it is better to recreate the record as needed for each separate application.

The design of the Library Management System in Los Gatos was to be the fourth generation of that library's system. The third generation, a partially integrated batch system, was characterized by one of the systems people as a series of high speed highway segments connected by bottlenecks. To achieve any real breakthrough in efficiency, the new system had to work in a totally integrated manner; all information had to be stored as a single logical file accessible to everyone, according to his needs. To achieve this mechanically, the file had to be on-line in a direct access storage device and accessible from terminals.

Not only is there economy in the production of records but, in having a single logical record, there is economy in utilizing records. Today in machine batch systems and manual systems, when a patron or librarian needs information about a book, he often has to utilize a number of different tapes or go to a number of different places: the catalog, the book shelves, the circulation file, the on-order file, the in-process file, or a branch or departmental library. This weary traveling from department to department to find various files is a fairly common complaint.

Another requirement for a system to be "properly applied" is that there be enough work for it. There has to be a minimum amount of work—a single threshold if you will—to make the system viable. The threshold depends not only on the complexity of the task, but also on quantity. If an expensive machine is idle most of the time, it would be better to have a human do the work even though he may be less efficient. At least he is more versatile and can use his idle time for a variety of tasks. Too often a system is used for a few, often trivial tasks; machines are then misapplied. It is senseless to use an automobile to travel a few hundred yards to perform a simple errand, although it is often done because of laziness, personal convenience or unthinking habit. It is wrong to build an interactive on-line system just to do simple lookup like identifying an author or an entry. If this lookup is part of a larger more complicated process, then it is entirely valid economically. It is only when lookup becomes a more complicated search that the interactive system comes into its own.

Two growth factors greatly affect the threshold level of a system: (1) the increased growth of the operation itself and (2) the decreased cost of the hardware. Originally data processing—and today interactive systems—was adopted primarily by growing and expanding operations. A stagnant or shrinking operation seldom feels any need for adopting new methods and techniques unless, of course, it becomes evident that the stagnation is due to the present inefficient methods. Also, a growing operation will grow into the economic capacity of a machine installation even though it may actually start below the economic threshold.

As Chief of the Library Branch of the Technical Information Division of the U.S. Atomic Energy Commission (AEC) in Oak Ridge, the quantity of



documents I had to process was increasing rapidly and Civil Service would not give me more personnel as the workload increased. Finally, in desperation, I asked for enough money to install some unit record equipment to do the work. I could not reduce staff and the machines would not be utilized for more than an hour or so a day, but I would never ask for any more people. I made a very rash promise twenty years ago, and today, although the amount of library processing put out by the AEC in Oak Ridge has increased manifold, they have not had to increase manpower and the machine capacities have been more than able to keep pace with the growth in demand.

As evidence of the decreased cost of the hardware, today, a small computer—and by this I do not mean the little mini-computer but the small general purpose machine that is capable of performing all the basic data processing jobs in the library—rents for the salary equivalent of one to two professional personnel. Seven years ago when library automation first got underway, the least expensive hardware configuration capable of doing the library's work cost ten to fifteen times as much. One should not forget that today's small computer is at least the equal in power, capacity and performance of that much more expensive machine. In addition to these small stand-alone machines, the increased availability of time-sharing facilities is also lowering the economic threshold to where the smaller libraries can afford to make use of data processing. One also should remember the tremendous potential saving that is possible by using shared data bases. Until on-line systems are utilized, such sharing cannot be fully exploited.

Looking at the total operating costs of the library, it appears that data processing, when properly applied, will either reduce costs or slow down the present rapid rise in processing costs. On-line interactive systems will be the preferred method for a number of applications both because of the economics of the situation and because of the inherent needs of the application.

## APPLICATIONS

One could spend an appreciable amount of time defining interactive systems based on level of communication. There is simple remote job entry or one-way communication. Typical examples are placing a hold on a book or recommending a new acquisition. At a higher level is two-way communication in a prescribed format. Examples of this might be placing an order with a vendor with a system check for duplicates or checking an authority file for correctness of entry. At the highest level a system might provide fully unstructured conversation.

Based on available descriptions of both library and non-library systems, one can extract those elements of an application which strongly influence a user to select on-line, interactive processing. Some of these elements have been

mentioned already, but they bear repeating. One is the need to transport the information directly to the user so that he will not have to spend time and energy going to the various sources. Librarians have recognized this problem in designing their workrooms and in locating the official catalog, the shelflist, the serials check-in files, etc. It is an accepted idea that library processing people must go to the various catalogs and files. Many workers develop their own little card files, indexes, authority lists and other working tools for convenience, to save time, to avoid walking to distant cabinets and shelves, and to avoid waiting in a queue while someone else is using the file or book. When the information is brought to the individual immediately as needed, and there is never a conflict or out-of-file situation as exists in manual files, then the productivity of the workers is greatly increased. Some have argued that physically going for information is a good distraction and breaks the monotony of the job. But such arguments are mostly rationalizations, certainly in the library.

On the input side, a good on-line system eliminates the intermediary transcriber clerk, usually a keypunch operator or typist. One does not need a separate operation to update the file. The originator of the information—the order librarian, the cataloger, the patron or clerk charging a book or discharging a loan, etc.—in creating the information is immediately creating the record and storing it. No new errors are introduced by a transcription clerk or by a defective work sheet. If any problems develop and if any proofreading or correction is required, this is done immediately by the person who has just created the record and who has all the pertinent information and materials at hand. Furthermore, experience has shown that there are fewer errors when the data is entered by the person familiar with it rather than by a keypunch operator.

Since the system is on-line, the normal editing by the computer can be accomplished immediately and the creator of the record can immediately take the necessary action. This adds up to faster turnaround time, faster and greater throughput. Mention has already been made of the large amount of recycling or looping back which is currently necessary in the MARC program. Figures are not available for the National Library of Medicine *Index Medicus* program or for other abstracting/indexing services, but all connected with such operations have complained about the burdens of double processing.

This recycling or looping back is due to the fact that the error is detected long after the transaction has been completed. As noted, in an on-line system each transaction is an inquiry which must be answered before the transaction is completed. In a batch system, the inquiry comes after the transaction has been completed and the parties concerned are either not present, as with a book loan, or the material has gone and the person involved is engaged in a new task, as in cataloging and ordering. As a result, more controls have to be built into a batch system than are necessary with an on-line system. In some

libraries the loan clerk may have to verify that the patron is a legitimate borrower and the book may be charged out. The cataloger may check the authority lists for every entry and verify every field, even though subsequently these may be machine-editing functions. The order librarian will carefully fill in all the boxes on the order form even though a large number of them carry default information such as method of payment, method of shipment, claim cycle and the like, simply because she is not absolutely sure what the stored default information is. In a good on-line system the completed order, including the default information which did not have to be manually entered, is displayed for verification and acceptance before final processing.

On-line processing guarantees the currency of records. The moment a record is created and stored, it is available to every inquirer. As soon as a journal issue is checked in, an order recorded, a book cataloged, or a loan discharged, that information is immediately available to everyone. There is no librarian in existence who has not, on many occasions, spent long frustrating hours trying to determine the status of an item. Most of this is due to the fact that the record is not available until long after the event.

Currency of information is of overriding importance in many commercial applications. That is why so many credit and banking applications, insurance processing, airline reservations and the like were pioneers and moved rapidly to on-line systems. Such urgency may not exist in librarianship, but it should if libraries are to have satisfied patrons. Too often the acceptance of delays in making information available and the difficulty in obtaining it reduce the utilization of such information and so reduce the use of the library. Furthermore there is little incentive to maintain such records. A case in point is serials holdings records. When its serials holdings records are first published, it is not unusual for a library to experience a 20 percent increase in the use of periodicals. It is often also startling and amusing to discover how bad the old card file of serial records are and how rapidly they are cleaned up and updated when they become highly visible in published form. In fact, the most difficult problem in building a computerized serials list is cleaning up the old card file. The bad record is usually not due to the fact that the information was not available, but simply because changing the record involved a lot of work and there were higher priority jobs demanding the librarian's or clerk's time. So at the most, a note may have been made which might act as a reminder.<sup>12</sup>

As already mentioned, the ability to obtain current information very quickly in an on-line system does away with the need for maintaining expensive paper files. Yet, since we have always had them, they are given up with great reluctance. When the RAMAC was first introduced and used for inventory control, the information was processed and stored in the machine, but the records that were consulted by the users were printouts. It took some time for people to give up their cherished lists and card files and go directly

to the computer which produced these lists and cards. Too often batch systems are nothing more than a new method for maintaining manual files and sometimes on-line systems are added on top of existing manual systems rather than eliminating the latter. This of course makes for very expensive operations. This is to be expected in new systems because of lack of confidence in the new and familiarity with the old. What is unforgivable is the continuation of the old beyond the minimum conversion period.

An interactive, on-line mode of operation is much more comfortable for the worker than a batch mode because there is no need to break up tasks to fit the batch. If it is better and more convenient, for example, to completely process an item before tackling the next job, even though it requires a variety of tasks, it can be done with the interactive on-line system. The batch system is most efficient when it groups a large number of items for a single task or a small number of operations. This can mean, for example, that the cataloger may have to handle the same book more than once. People find it distracting and confusing to handle many different items in a single batch. There is the problem of broken continuity of thought and the problem of remembering.

One must admit that the efficiency of some catalogers would be improved if they did a little more batching. However, the mere fact that the batch mode is essentially a procrustean bed, inevitably forces the human to accommodate himself to the machine, which can be undesirable. In an interactive system the user can shape the application program to suit his requirements as in command chaining, variable file access, choosing different functions, etc. In essence, the human controls the order and sequence of events, not the machine. The system is said to be user oriented. A batch program, however, is absolutely rigid. Although it may be able to turn out a great variety of individual, customized products, the operational sequences are programmed and unchangeable. A good interactive system should not have any of the dehumanizing aspects that too often characterize our big, industrial society.

At this clinic there is understandably no example of an on-line, interactive reference system. The only ones that exist in libraries are for certain specialties, are experimental or are confined to limited collections. The machine-readable files of large, general collections have not yet been built. These are necessary before truly adequate reference work can be performed. The search and retrieval functions that do exist for general collections are used entirely to support the various technical processing functions in the library.

The major research on interactive, on-line systems involve search and retrieval functions. It seems that this is the main interest of information science; it is certainly the dominant theme in that literature. This clinic restricted itself to the immediate problems of librarians, deferring for possible future consideration all the topics associated with reference work, while

recognizing that much of the original impetus to adopt interactive, on-line systems was to improve search and retrieval. I will, therefore, mention only a single aspect of the search techniques possible with on-line systems since it has a profound effect on library technical processing.

The computer can dynamically organize and structure files. By the use of Boolean operators or multiple access points, it can organize lists and compilations extracted from the data base in many different sequences and with various populations. In a manual system this is not possible since everything is filed in a single sequence. For example, to receive a book, the user must search the outstanding order file. To search the file to answer an inquiry about the item, the user must know the entry which is used to sequence the file. If the original entry is incorrect, which happens frequently, or if the original inquiry does not have all the necessary information, then the user will have difficulty in generating an entry compatible with the file entry. The mark of a good receiving clerk is his ingenuity in solving such snags. A good on-line system provides multiple access points, not only from the individual fields on the order—author, editor, publisher, vendor—but also includes fully permuted titles and corporate authors. The availability of any one of these single clues is sufficient to retrieve the record. In addition, even partial clues using indeterminate search keys such as truncated and compacted terms to find authors, titles, etc., when coupled with the browsing capabilities made possible by the display terminal, greatly improves our searching capabilities beyond anything in the past.

These search strategy capabilities can, in part, exist in a batch system but their utilization is much more restricted and awkward. The user, for example, can submit a query in various different arrangements and then look at the various printouts to see which was the lucky one. Or the user could go through a series of search strategies until he or she is satisfied, but in every case he or she must wait for a completed search before trying a new search strategy. In an on-line system, by seeing what intermediate results are, one can carry out this exploration quickly and efficiently modifying the search as he or she picks up clues, scans lists, etc. There is a proper division between the intellectual processes which the human does and the mechanical processes which the machine does. This is the essence of interactive processing.

Another example is indexing. The present arguments between machine indexing and human indexing should really not take place. Rather, one should examine very closely what aspects of machine indexing can be integrated with human indexing to generate the best index possible. This is a topic which cannot be covered at this clinic. The exploitation of the interplay between what the machine can do and what the human can do is what will really advance the state of library technology. Format recognition as exemplified by the current RECON project will only be really successful in an on-line interactive mode.

Obviously, successful library systems of the future will be hybrid systems, partially manual, partially batch and partially on-line. Data processing people are trying to build the best possible operating system for the library, and they are going to make use of many different technologies and a great variety of systems.

Interactive use of stored communicable and dynamic data bases will undoubtedly have a profound effect on the role of the library in our rapidly changing bibliographic world. For example, on-line systems being developed in business and industry are tending toward the building of large, central, integrated facilities. In the library this will mean everyone having access to large, shared data bases like union catalogs and massive inputs, like MARC outputs, now available only to a very few large libraries. This does not inhibit the development of small, stand-alone systems that perform all the local tasks such as circulation control, periodical check-in, and binding control. Librarians should ask themselves how having what is sometime referred to as a computer utility will affect libraries.

Another subject for speculation is the suspicion that the successful exploitation of retrieval systems and the widespread use of libraries as sources of information will come primarily not because of any improvement in indexing and retrieval methods, but because getting the needed information will be made convenient and easy. When the library terminal becomes as ubiquitous as the telephone, libraries are going to play a much larger role in information processing and transmission.

An even more radical idea is that as interactive systems open the door to new forms of information storage and information transfer, some people are talking about the abolition of all hard copy. Potentially the librarian might have little concern with books, periodicals and other printed matter.

It is tempting to speculate as new tools open up opportunities for new methodologies and services. But in view of the real interests of this clinic's participants, this presentation has been kept to mundane, immediate and practical topics. Library technology is moving in the direction of on-line, interactive processing and it is important that it be done well.

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## The Ohio State On-Line Circulation System

The Ohio State University (OSU) Libraries is a network of approximately twenty-three department libraries and the main library. The number is approximate because the question of which libraries classify as department libraries presents some problems. For instance, Ohio State University has a library on Gibraltar Island in the middle of Lake Erie, accessible only by boat, and open only during the summer months. It is, in fact, a subbranch of the Biological Sciences Library and is not counted as one of the twenty-three department libraries. The library in Perkins Observatory in Delaware, Ohio, is counted in the twenty-three department libraries, as is the library at Children's Hospital. There are certain libraries on the campus which are not a part of the university libraries system. The Law Library lists its material within the system, but does not have a terminal and does not use the system for charging or for access, but purely for information. Privately endowed libraries and libraries supported by certain departments such as the English Department Library and the Philosophy Library, which are primarily libraries for undergraduate reserve reading, are neither part of the university libraries system, nor are they under the jurisdiction of the libraries.

The library system contains approximately 2,500,000 volumes. The acquisition, cataloging, and serial recording are done centrally and the finished items are then sent to the various public service units. In 1972 the libraries will circulate approximately 1,500,000 volumes. They will purchase some 120,000 volumes and on a busy day 20,000 patrons may enter one of the libraries within the system. The campus is large and decentralized and the distance from the Veterinary Medicine Library to the Education or Commerce Libraries is well over two miles. The libraries serve approximately 70,000 patrons, as listed in the patron name and address file.



During the 1960s the Ohio State University Libraries became increasingly aware that library circulation was not increasing at the same rate that enrollment was. The analysis of this phenomenon seemed to demonstrate that the system itself was clogged, that is, the procedures that had been evolved over the previous century were insufficient to meet the demands and load level that the increased size of the institution was placing on the library. Newer methods of teaching and research were also placing heavier demands on the libraries.

To simply expand the staff and the concomitant files and checkout desks seemed to be both inappropriate and unlikely to receive funding from the University budget authority. Furthermore, due to inflation, the costs of personnel were rising at an enormous rate. The libraries therefore decided to design an automated circulation system in order to recapture some of the lost circulation and to provide a system which would be expandable in the future at minimal cost. As the requirements for the system were designed it became clear that the system should be one which would speak to the problems of its users rather than simply the problems of the library. The most common user complaint arose from attempts to borrow materials from the library only to discover that the materials were either not owned by the library or were checked out. Another common complaint was that to locate a spectrum of materials on such a large campus and in a library situation which was fairly decentralized was a frustrating and time-consuming operation; a trip from the main library where the union catalog (wherein all the books on the campus are listed) is located, to another library would often prove fruitless since the materials were either checked out or the patron had gone to the wrong library.

Although materials were available to patrons if they would go to the right library, people would often not try all the possible alternatives of libraries where a copy might be located when they discovered the copy located in the particular library they were using was out. Therefore, rather than a system which would keep records of "books out" only, it was decided that full inventory control was needed. Furthermore, we felt that we must design a system which would provide for remote access and the ability to display all of the libraries holdings at any of the libraries' many locations as a basis for sharing of resources rather than a buildup of duplicate libraries. A fair amount of duplication is necessary in a campus of the size of Ohio State University, but it was hoped that in the future one department library could forego the purchase of little-used material if another library on the campus had the material available and it was readily accessible by a patron in the first location. This kind of cooperation is just beginning and should increase in the future.

The next problem was the amount of data needed on the file in order to satisfy a large portion of the patrons' demands. At about the same time that

Ben-Ami Lipetz at Yale completed his studies on card catalog use in a major academic library, his findings were verified by findings at the University of Michigan which pointed to the fact that about 80 percent of the patrons who enter a library know the items they want and they are engaged in a known item search. Of the remaining 20 percent, a fair proportion are engaged in a subject search, and the others are engaged in a search by series, for a group of documents, or for bibliographic information only.

With this information at hand it was decided that the system should involve an author-title and title search capability, but not subject search capability. There are so many unanswered questions about the "subject search process" that data are still being amassed about it. The university then selected the IBM Corporation to draw up the functional specifications for the system and to program the remote access and circulation system. This required 5 men for 15 months or 75 man-months, costing \$225,000. A vendor was selected to convert the library records. Records include: the call number, author, title, LC card number (in case subject information was added later, a link would be needed to other bibliographic records produced at other institutions), an internal identification number or title number, date of publication, a tag designating the item to be English or non-English or serial or monograph, and the holdings—that is, the volumes and copies of the particular title and where they are held. The average master file record is 100 characters in length. The OSU Libraries use the Library of Congress classification scheme with certain exceptions. The Education Library's juvenile collection is Dewey Decimal, the theses and dissertations are in an arbitrary sequential number contrived from the author's last name as well as the year and level of thesis. Microforms use simple sequential numbers and the Law Library uses another classification. Thus we have a mix of call numbers which demands a free and variable length field containing both numerical and alphabetical characters. The programs themselves are formed in approximately ninety-four separate modules and at any one time demand 186K of core of the IBM model 360/50. The "Fifty" seems to be the smallest machine which has the necessary channel speeds for the system. The system has approximately thirty 2740 typewriter terminals and approximately ten 2260 CRTs (fig. 1). The patron may telephone and request a search by author-title, by title, or by call number, and the library can respond as to whether the libraries owns the items, whether it is charged out, and in which library it is housed. It can also charge the book to the patron if he has a valid identification number. The system carries approximately 70,000 names and addresses with corresponding identification numbers as well as 1,000,000 titles comprising 2,500,000 volumes. Books may also be renewed by telephone. If a patron comes to a circulation desk with a book in hand, rather than do a search, the book can be charged by simply typing the call number and the patron identification number at that keyboard and the machine will respond with the author, title, date due, and date charged on a

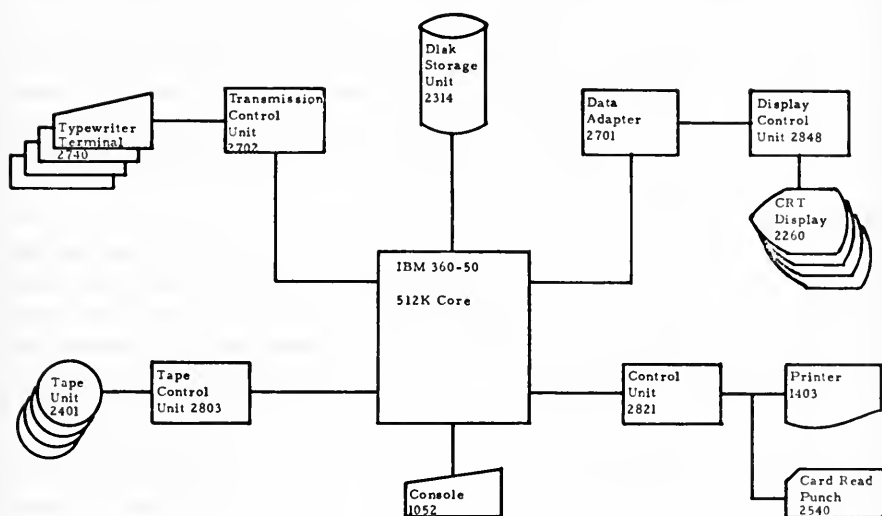


Fig.1.Hardware

slip of paper which can then be inserted into the book. On a remote charge the same data appears in the library where the book is located; the book is paged and awaiting the patron when he arrives at the circulation desk.

Any library can charge any other library's books, but only the home library can discharge books. The discharge routine is similar to the charge routine except that the patron's identification number is not needed. Thus, the stock of each unit is protected and controlled by the discharge routine. The machine automatically generates "holds" or "saves," "recalls" from faculty members for books that have been out more than three weeks when requested by a student or other patron, and provides a lists of "snags," that is, books not on the shelf and not charged out which are searched to see if

they are misshelved or some other error has occurred. Bills for "lost" books or accumulated fines are also generated by the system.

The system was first started in November of 1970. Circulation has risen over 40 percent in the eighteen months the system has been operating. With the rises in wages, circulation costs are now about the same as before installation of the system, about \$0.43 or \$0.44 per circulation. About one-half of the circulation is still done manually—almost all of this is from the reserve rooms, since the old system of writing one's name on the end of a long card is still faster for controlled access materials than keyboarding. The university does not have a machine-readable identification card. If such an identification card is issued, manual circulation for reserve materials will be switched to the 1050 terminal or some other terminal which can read both a Hollerith card and the borrower badge in a very short time. The library encouraged the university to switch to such a machine-readable identification card and it appears that some action may soon be forthcoming.

In January of 1973 an automated acquisition and serial system will be initiated. Much of this data will reside in the Ohio College Library Center's Sigma 5 XDS machine, but will utilize the OSU Libraries' terminal system and circulation system. In essence an acquisition will be dealt with in the same way a circulation is dealt with; i.e., it will be treated as a book that someone has checked out of the stacks which must be returned; much in the same way that someone who has charged the book owes the library a book. In effect we will create a record on the file and charge it to a vendor with a date due, just as if he were a patron. It will display on the system with perhaps a prefix "V" for vendor identification number and a date due. The vendor, if he does not supply by the date due, will receive an overdue notice, only we will call it a "claim." To a patron or a user of the system the books on order will look the same as the books already owned by the library except that rather than a call number, an order number or an invoice number will appear. A book may be reserved when it comes back from a patron even if the patron is a vendor. The libraries will then be able to circulate uncataloged books and defer cataloging for items which are needed immediately until after the initial use. The system has the ability to expand to 200 to 300 terminals before degrading the response time.

Some of the more interesting phenomena that we had not realized when we did the original design and programming are:

1. On-line systems should, in fact, have on-line maintenance. We had anticipated that batch maintenance would be the most efficient and easiest method of updating the system. This is simply not true. When a system is running as many hours as ours is, it becomes feasible to "time-slice" and do maintenance routines in between circulation transactions. The batch routines take an enormous amount of time at least once a week, and do not have the instantaneous need for updating that an on-line system does.

The process of backing up the system, doing the batch maintenance, and then re-backing up the new file is extremely expensive and time-consuming. It is not in any way cheaper or more efficient than an on-line system. We hope to have the on-line programming finished by August 1972 so that we can stop doing batch processing of updates. We now have the ability to maintain the name and address file on-line, but the master file of books and journals is far more complex; there are problems such as identifying or holding from maintenance the change to records of books which are in circulation.

2. We had set up the on-line system believing that some of the smaller department libraries could share lines into the computer. This proved to be untrue—queuing problems quickly occurred and soon became intolerable. Furthermore, we discovered a large amount of unforeseen traffic of department libraries searching for added copies or added editions of materials held in those libraries, but which were either checked out or not available at the moment. The interdepartmental traffic is a very large portion of the total system traffic.
3. We discovered that certain kinds of unforeseen reference operations have played an important part in the reference services using the computer. The checking of standard reference books, especially bibliographies, for those items which we hold is now being done on a large scale. The reference librarians use the terminal provided in the reference department not only for such housekeeping routines as charging to themselves the latest volume of those series labeled “latest volume in Reference,” but also for answering catalog information questions. Since so much of reference work is the matching of bibliographic sources against library holdings, there is extensive use of the terminal in that department, although very little actual “charging” and “discharging” is performed.
4. We are beginning to be able to limit the number of duplicate copies being provided in the system since all of the copies of a book are available throughout the system. We are not forcing this particular issue, but are discovering a tendency among the various department librarians to “stretch” their book budgets by cutting down on the duplication of material that is used heavily a few times a year, but sits idle the rest of the year.
5. We are exploring the possibility of using the system as a sort of sub-standard cataloging by providing limited entries on a permanent basis for the kinds of materials that are duplicated in many copies—sometimes hundreds of copies—for the History 101 courses, for general undergraduate reading, and for the browsing room. No definite decisions have come from this, but we have received the recommendation that added copies of popular items be listed only in the computer and never fully cataloged.

The system also sends certain statistical reports to the library as well as purchase alerts to the acquisition department for items for which there are more than two "saves" and reduces the circulation period to one week for all books when more than three "saves" are present on a given title. We expect that the circulation will continue to increase, and by displaying the on-order file with the circulation file, we will be able for the first time to have full control of the materials both on the shelves and in the pipeline to those shelves.

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# LOLITA: An On-Line Book Order and Fund Accounting System

LOLITA is the project name for the on-line book order and fund accounting system developed by the Oregon State University Library and used since mid-March 1970. Although designed primarily to handle monograph orders, serials and binding are included in the fund accounting portion. This paper will discuss approximately two years of production work with LOLITA: the changes in the work load caused by LOLITA, the effects on the overall acquisitions program, program revisions, and operating costs. The overall design philosophy, record formats, and on-line processing of these records were detailed in "On-Line Acquisitions by LOLITA" by Spigai and Mahan.<sup>1</sup> Additional detail, particularly in regard to fund accounting was described in "LOLITA: An On-Line Demonstration" by Baker *et al.*<sup>2</sup>

The Oregon State University Computer Center has a CDC 3300 computer which is operated under OS-3, a locally developed timesharing system serving a network of remote terminals around the state of Oregon. Depending upon the nature of the computing work being done by individuals, the system can support in excess of sixty concurrent users. System reliability both in terms of hardware and software, is excellent: downtime is measured in hours per month.

The name LOLITA was chosen for its acronymous value, standing for Library On-Line Information and Text Access. Although we like to think of the promise for the future the project name holds, we sometimes agree with

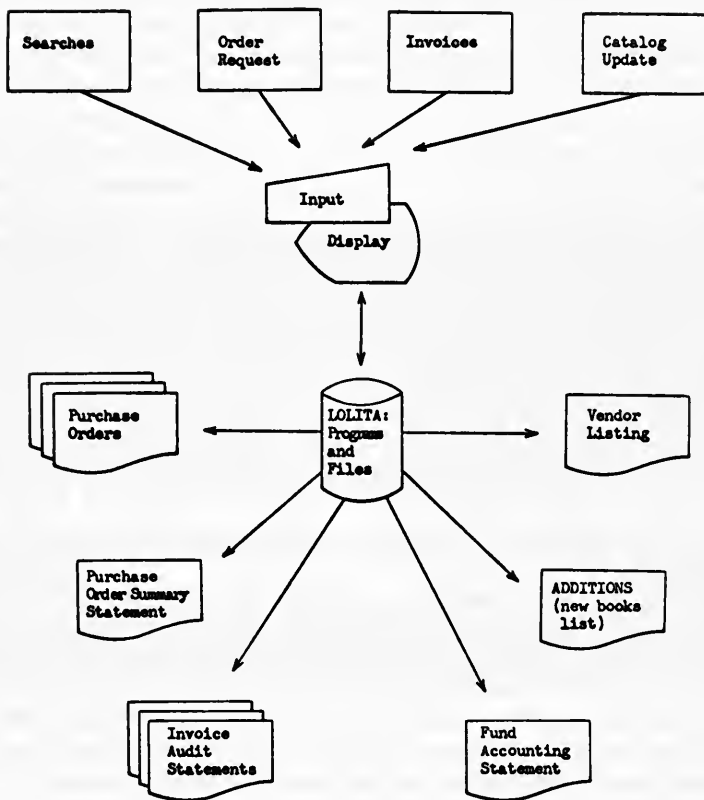


Fig 1. Flow Chart of LOLITA

Frederick Kilgour who suggests that, in his view, LOLITA is "a dangerous name, replete with suggestion."

In LOLITA one can see a near fusion of technology and Robert Graves's White Goddess. LOLITA is oriented to the service of humanity: wherever possible LOLITA accommodates people rather than requiring that people accommodate the machine. Robert Graves's *Seven Days in New Crete*<sup>3</sup> describes a sort of Utopia in which the Goddess is supreme and all technology denied. But the climax of the story includes an admission that knowledge and technology are not evil in themselves but only according to the purposes to which they are put. A humane use of the machine, such as we believe LOLITA to be, is acceptable to the Goddess.

Fig. 1 is a simplified flow chart illustrating the major functions of LOLITA. The files on which LOLITA depends include on-order/in-process, vendor, and fund accounting.



Certain operations are oriented to a cathode ray tube (CRT) terminal; the on-order/in-process file can be searched by purchase order number or author. New orders are input and automatically indexed on a daily basis. Invoice data are added to records or, for serials, standing orders, and binding, set up in a separate file, again on a daily basis. Finally, the catalog updating (addition of call number, corrected main entry and title, and other changes) is also done on a daily basis.

Other functions, particularly where a paper document as an audit trail is desirable, are oriented to a Teletype terminal; periodically on demand, but normally once or twice a week, purchase orders are prepared for printing. As the purchase orders are prepared, the fund accounting and vendor files are updated both in terms of new orders issued and invoices processed. Purchase order, invoice, and fund accounting statements are automatic by-products. The vendor file, which includes cumulative counters for frequency and dollar amounts for each vendor, can be accessed at any time for display and maintenance (updating, correction, additions, deletions) or a complete listing can be produced on the line printer. The fund accounts are readily accessible on-line on demand so that the current status of each budget line item and each subject category is always available. Summary statements for all fund accounting can be produced on the line printer by command from the Teletype. A special program for entering new fund allocations, corrections, and transfers is also available to authorized personnel.

The book, serial, and binding budget for the Oregon State University Library varies from year to year. Encumbrance accounting is used, and funds committed to cover a given purchase order may be carried forward into the new fiscal year; while these so-called outstanding funds are not really part of the current year's budget, they do constitute a part of the acquisitions work load. Budget figures for four fiscal years, from pre-LOLITA to the present, are shown in table 1. Note that the figures for 1971/72 new funds are an allocation; the final year-end figure could be higher (or lower). Also included in table 1 are the catalog statistics for volumes and titles added during the same time period. Incidentally, a major portion of the monograph funds for 1970/71 were not made available to the library until the final months of the year: many of the items ordered were not received until 1971/72. Thus, the flow of new materials coming to the catalog department is uneven; however, the department is operating without a backlog.

### **LOLITA's Effects on Staff**

The acquisitions staff has remained stable in size over the last four years so that the number of persons doing acquisitions work before and after LOLITA is the same. The full-time employee equivalent is eight; the number of full-time student assistants is two. Acquisitions work includes: coordination of

	1968/69	1969/70	1970/71	1971/72 (est.)
New funds including gifts	\$367,346.34	385,668.65	406,221.36	(375,918.00
Outstanding funds carried forward	33,036.06	28,284.71	28,031.65	76,019.42
Total	396,782.40	413,953.36	434,253.01	451,937.42
Volumes cataloged (gross)	32,082	31,701	29,580	32,000
Titles cataloged (gross)	14,206	15,105	10,738	14,500

Table 1. Budget and Cataloging Workload

collection development, preorder searching, gifts and exchanges, issuance of purchase orders, receipt of materials, and invoice processing along with the normal complement of correspondence, claims, snags, incorrectly mailed packages, and visiting sales representatives. A separate serials control unit—for which the full-time equivalent (FTE) is not included in acquisitions—receives serials and handles most serial claims; however, processing serial invoices is a part of acquisitions.

Although staff has not been reduced as a result of LOLITA, there have been significant changes in the work performed. Some of the changes are a direct result of LOLITA; others reflect organizational changes, some of which could not have been done without LOLITA.

The total book, serial, and binding budget has grown (see table 1) but, with inflation, the effective increase in terms of purchasing power is not great.

The serials control staff has not grown during the past four years even though the number of subscriptions received has increased by approximately 13 percent. (Serial titles—including duplicate copies—received as of July 1, 1968 were 13,554; by October 1971, the number had reached 15,285, an increase of more than 1,700 titles.) Since additional serials staff could not be obtained it was necessary to reassign certain tasks in order to reduce the work load in serials control. Bibliographic searching of new serial titles is now performed in acquisitions; gifts of serials, which often show up by the box load, are now handled by acquisitions.

LOLITA produces a unique four-part purchase order for each title ordered. The fourth copy is used as a work slip in the catalog department. Before LOLITA, acquisitions spent more than eight hours per week typing special cataloging work slips, one for each title. The one-fifth FTE savings created by eliminating the hand typed work slips is a direct result of LOLITA.

A further savings is in the catalog department where, formerly, Oregon State System of Higher Education rules required that bill data (invoice date, vendor name, price, fund name) be typed on the shelf list card. Since LOLITA assigns a unique purchase order number to each title, the catalog department now types only the purchase order number and price (rounded off to whole dollars) on the master card. There is a definite savings in labor plus a significant improvement in the audit trail which we are required to maintain.

For many years the catalog department turned out a highly selective, hand typed monthly list of new books. Acquisitions, with the assistance of LOLITA, now turns out "Additions," a bimonthly list, at approximately one-half the cost. "Additions" automatically includes those items ordered through LOLITA and subsequently cataloged; thus, a complete current record of the cataloged additions (including replacements and duplicates) is assembled except that items received on standing order are not yet generally included. As each item is cataloged and put onto the shelves, the call number and the date cataloged are added to the record in LOLITA's files. This causes a transfer of this record from on-line to magnetic tape which is processed bimonthly. The author, title, date of publication, and call number of each new item are extracted and grouped into sixty-three subject clusters and subarranged by author. Then the list is output on the line printer and sent to the university printing department where it is photographically reduced to 65 percent of its original size. After printing, the list is distributed to the departments and administrative offices of the university. A short extract from "Additions" is reproduced in fig. 2.

After the first issue of "Additions" (December 15, 1970) we received a number of adverse comments regarding poor legibility. By the time the second issue came out two months later a new line printer had been installed which featured a markedly improved type face as well as better controls for vertical spacing. Legibility ceased to be an adverse factor.

Early in March 1971, after the second issue of "Additions" was distributed, a questionnaire was sent to each member of the Oregon State University faculty. About one-third of the faculty responded. Table 2 summarizes the response.

"Additions" was originally arranged into fifty-eight subject groups based on the initial letter or letters of the LC classification system; sequence within each group was by main entry. More specific subject groups could be created by sorting more of each call number, but the costs would be significantly increased. Fifteen additional subject groups were added to meet special and/or

U. L. B. K. . . . .  
 VAI. . . . .  
 WALLACE, JOSEPH, CHARLES (EDITOR) SOME GREAT MEN OF OUELLE (1968) (1968) 1 LC37.031/43/1968A  
 (ESSAY INDEX ALPHABETIC SERIES)  
 WILLIAMS, SYLVIA BERRY HASSLING (1978) LD7531/.P22/MS  
 ENGINEERING, CHEMICAL  
 LESCH, ALMA VEGETABLE DYEING: 151 COLOR RECIPES FOR DYEING YARNS AND FABRICS WITH NATURAL MATERIALS  
 (1978) TP919/L47  
 MEMBRANE SCIENCE AND TECHNOLOGY MEMBRANE SCIENCE AND TECHNOLOGY: INDUSTRIAL, BIOLOGICAL AND WASTE TREAT-  
 ENT PROCESSES. EDITED BY JAMES E. FLINN (1978) TP156/.C65/H615  
 SCIENCE OF CERAMICS VOLUME 5 TP789/53  
 TRESSLER, DONALD KITELEY, JOSELYN, MAYNARD A. (EDITORS) FRUIT AND VEGETABLE JUICE PROCESSING TECHNOLOGY  
 (1971) TP562/T698/1971  
 TREYBAL, ROBERT ENALD MASS-TRANSFER OPERATIONS. (MCGRAW-HILL CHEMICAL ENGINEERING SERIES)  
 (1967, C1968) TP156/.M3/T1  
 ENGINEERING, CIVIL AND GENERAL  
 AIR/WATER POLLUTION REPORT. BINDERS. 3 BINDERS Y883/46  
 AMERICAN PUBLIC WORKS ASSOCIATION, OREGON CHAPTER. STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION  
 N. 1978 (1978) TA181/.U6/43  
 ANTILL, JAMES M. CIVIL ENGINEERING MANAGEMENT (1978) TA190/466  
 APPLEBAUM, SAMUEL S. OSMINERALIZATION BY ION EXCHANGE IN WATER TREATMENT AND CHEMICAL PROCESSING OF OTHER  
 (1968) (1968) TQ480/.77A66  
 BENJAMIN, JACK RALPH PROBABILITY, STATISTICS, AND DECISION FOR CIVIL ENGINEERS (1978) TA368/866  
 BERG, NEIL / LOHMY, N. LITAN P. TREM. "VICTIM" ITV AT SALEM, OREGON, 1958-1967. (1968)  
 (1988/.5)  
 "ANTICS (1964) "A"  
 "M"

Fig. 2. Extract from "Additions"

cross-disciplinary needs: three were separated in economics; the remaining twelve could be separated only at greatly added expense.

The most urgent problem reflected in the questionnaire was one of circulation. Publicity in the University's *Staff Newsletter*, admonitions in "Additions," and notes to departmental secretaries stapled on the front cover have done much to increase the size of the readership of "Additions." We distribute an average of one copy of "Additions" per ten faculty members. As far as can be determined this is an adequate level of saturation.

The total effect of the other questionnaire comments was to approve the organization of "Additions," the data provided, its frequency, and its distribution. The dissenters were a small minority and by no means in agreement with one another.

Since July 1971, acquisitions has been filing one copy of each invoice processed; previously this task (requiring four to five hours per week) was performed by the Oregon State System of Higher Education (OSSHE) Dean of Library Services Bookkeeping Office.

These increases to the acquisitions work load could not have been absorbed without LOLITA. Indeed, before LOLITA, acquisitions was having difficulty keeping orders going out and invoices processed; files lacked maintenance, and claims were an irregular and infrequent consideration. Now, with LOLITA, the files are being maintained, claims are being handled on a regular basis, and the added work load factors described above were easily absorbed.

<i>Responses</i>	<i>Percentage</i>
Had not seen	72.2
Found useful within or outside their subject area	82.4
Were satisfied with format, arrangement, and reproduction quality	88.8
Felt a list of materials should be published	94.2
Monthly	24.6
Bimonthly	31.8
Quarterly	37.5
Annually or biannually	6.1

Table 2. Faculty Responses to "Additions"

Clearly, then, LOLITA has had a positive effect on the acquisition staff's ability to perform its normal functions. Not only is the quality of bibliographic and fiscal control improved, but acquisitions has, with no increase in staff, taken on at least the equivalent of one and one-fifth FTE positions in added responsibilities. To maintain the present level of bibliographic and fiscal control would require the addition of at least two and probably three FTE positions to the acquisitions staff. This sounds like an extravagant statement, but a proper comparison of a manual and an automated system must look in two directions: (1) at the relative difference in cost between the manual system and the automated system which followed, and (2) at the cost of manually attempting to achieve the controls and benefits of the automated system. The first figure alone may make the automated system look expensive, but the second figure shows a manual system to be even more expensive.

### Bookkeeping Office

During 1970/71 the OSSHE Dean of Library Services Bookkeeping Office continued to do fund accounting for Oregon State University Library as it had done for the last four decades. This paralleled the fund accounting done by LOLITA. By the end of the year there were no doubts about the integrity of the accounting performed by LOLITA, for the parallel fund accounting had demonstrated that LOLITA was more accurate, more timely, and vastly more detailed than the human bookkeepers (who were quite good). Beginning July 1, 1971, the fund accounting done by LOLITA is the official accounting. A

listing of the invoice input is audited by the bookkeeping office, but it does not duplicate any of the work done by LOLITA. Thus the work load of the bookkeeping office has been significantly diminished.

As noted, an encumbrance system of accounting able to carry forward committed funds into the new fiscal year as outstanding funds is used. In order to do this it is necessary for the bookkeeping office to provide the controller with an itemized list of purchase order numbers and accompanying encumbrances; this monstrous task requires days of tedious work. On June 30, 1971, LOLITA produced Oregon State University Library's outstanding order list in about twenty minutes (wall clock time) and at a cost of about \$20. Three weeks later the bookkeeping office was still compiling the outstanding order lists for some of the other libraries in the OSSHE.

### Serials Fund Accounting

LOLITA, as originally conceived, was to be strictly a monograph order system. However, as planning for fund accounting was underway, it was decided that all book, serial, and binding funds would need to be included if the fund statements were to have either validity or utility. Expansion of LOLITA to include serials receipts was out of the question. Instead, TFINVO was developed—a program for cathode ray tube (CRT) input of invoice data for serial, standing order, and binding invoices for which LOLITA has no outstanding purchase orders. The operator inputs some or all of the following: account number, actual price, estimated price, vendor code, invoice number, invoice date, total amount of invoice, or purchase order number. On redisplay the flagword TFIN is automatically supplied indicating to the fund accounting programs that the invoice was received on a TF ('til forbidden) order. The operator can make any necessary corrections at this time.

Some invoices contain several different TF items; for these the flagword is changed to MINV (multiple invoice) so that the repetitive data (vendor code, invoice number, invoice date, and total amount of invoice) are carried forward, and the operator need only fill in the account number and actual price. This program is not only efficient, it is very fast. For a credit memorandum, the data are entered as if for an invoice and the flagword changed to CRED (credit).

TFINVO has made it unnecessary to convert all old orders to LOLITA but, at the same time, has allowed for a single set of fund accounting procedures. For an item received and invoiced on a purchase order issue prior to LOLITA (and carried in the outstanding fund) the flagword INVO (invoice) is used. Thus there is provision for entering estimated price and purchase order number in TFINVO. Similarly, if one of these old orders is cancelled, the flagword CANC (cancel) is used.

## Flagwords

One of the features of LOLITA is the set of flagwords with which a number of logical situations can be controlled. For a normal purchase order the flagword is blank, upon receipt of the title and the invoice, the flagword is changed to INVO. The Spigai and Mahan article described twelve flagwords with which cancellations, confirmation orders, partial shipments, etc., could be handled.<sup>1</sup> We naively assumed that everything we ordered would be cataloged with some sort of call number; we were wrong.

A number of items are received which do not receive a call number per se, such as phonodiscs, microforms, vertical file material, maps, and curriculum library material. The item which really demonstrated the problem was the title purchased to be exchanged for another title from Southeast Asia. Not only did we not plan to catalog the book, we shipped it overseas the same day we received it. Then we found that there was no way to remove it from the files! The flagword KILL could have been used but this is usually reserved for cleaning the files of cancelled items. The solution was the addition of the flagword NCAT (not cataloged) which permits removal of the item without the necessity of a call number. NCAT does not require any call number; however, it is possible to use one of five pseudo-call numbers in combination with NCAT for identifying certain special collections: MAPS, DISC (for phonodiscs), CURR (for curriculum library), MICR (for microforms), and VERT (for vertical file materials).

From the beginning LOLITA has had the ability to handle partial shipments by use of the flagword PART (partial). This ability has been further refined by the addition of the flagword MORE. When the first installment of a partial shipment is received, the flagword PART is entered permitting the invoice in hand to be paid and, at the same time, permitting the order to be kept open for further receipts and payments. Thereafter, whenever the item is displayed, the flagword PART will be shown along with a set of special instructions for the operator. If further shipments are expected, the flagword MORE is typed in and the order remains open. If no further shipments are expected, the flagword INVO is typed in and the order is closed for accounting purposes.

The flagwords HELD and GIFT (included in the Spigai and Mahan article<sup>1</sup>), continue to be used, but with expanded capabilities. While none of the items identified by either of these flagwords are considered in terms of fund accounting, LOLITA does compile special data. HELD orders are those titles which are input for bibliographic control while awaiting funds to permit their purchase. Books given to the library and selected to be added to the collection are similarly input so that all monographs can be handled with one set of procedures. Two pieces of information are appended to the fund accounting statement: (1) the dollar amount of HELD orders currently in the

files, budget line item by budget line item; and (2) the cumulated evaluation assigned to gift books added during the fiscal year.

The addition or deletion of a flagword constitutes only minor surgery for LOLITA. Such changes must be made carefully because they are the levers by which control is exerted over the various conditions which develop in the course of ordering books and maintaining fund accounts. However, the structure of the program assumes that as new conditions develop, flagwords will be added or deleted.

### Miscellaneous Refinements

Simplification of acquisitions work procedures and improved efficiency are constant and ongoing goals of the LOLITA project. Some program adjustments are minor points, while others assume major significance. For example, LOLITA originally required that the operator key in the order date. A simple program change provides this data element automatically and at less expense than could be done manually. If for some reason a different date is preferred, it is simply written over the supplied date.

Similarly, LOLITA originally required that the operator key in the number of copies being ordered. Since more than one copy of a title is rarely ordered, "1" is now supplied as the number of copies to be ordered and the operator may override the number if more copies are being ordered.

The CRT input routine for new book order data is divided into three sections: a page of bibliographic data, a page of fiscal data, and a page of miscellaneous or inventory data. Again, the original program versions required that the operator proceed through all three pages even if there were no data to be entered on the third page. A simple exit key now permits the third page to be bypassed if it is not needed.

### Author Search

The Spigai and Mahan article stated that "Searching programs have been completed which will search by order number and by author."<sup>4</sup> The order number search has worked faithfully from the beginning. The author search also worked but with a severe limitation: it required an exact match. In other words, in order to retrieve an author, one had to enter the search in exactly the same form down to the last letter, space, and comma. Even searching for John Smith was a problem if he had a middle name. Corporate author searches were generally only a last resort.

In January of 1971 a simplified author search was implemented which is so successful that the exact match search is now only rarely used. The simplified search requires that the first four (or fewer) letters of the author's surname be input. With our on-order/in-process files which are stabilized at



about 6,000 orders, this four-character search has proven to be more than adequate. If the files were to be expanded to 18,000 items, the four-character search would probably still be adequate although its efficiency might begin to show degradation.

When the operator enters four characters for an author search, one of the following will occur:

- (1) LOLITA will indicate that no authors whose names begin with this initial combination of letters occur in the files;
- (2) if only one item in the file meets the search specification, the bibliographic page of that item is displayed; or
- (3) if two or more names qualify, a numbered list of authors' names is displayed. By keying in the number opposite the desired name, one of two conditions can occur:
  - (a) if only one item by that author is in the file, the bibliographic page of that item is displayed, or
  - (b) if two or more items by that author are in the file, a numbered list of titles is displayed.

Fig. 3 is a simplified flow chart illustrating how the author search program works.

After one has looked at a displayed item, an escape key (an equals sign followed by pressing the SEND key) causes a redisplay of the numbered list of authors' names for that search. The list is held in core memory and remains available for further use until the operator signals that the list is no longer needed; the list can be discarded by typing NC (no choice) which brings one back to the beginning of the search program.

LOLITA does not differentiate between an alphabetized and a non-alphabetized group of order requests. However, if one is working with an alphabetized group, it is sometimes possible to input only two or three letters and, thereby, search several items simultaneously. For this reason and because other library files require that the requests be alphabetized, normal work is done with alphabetized groups of requests. Of course, it is possible to search a difficult item under several different possible entries in succession without disturbing the sequence of the requests in the group.

In some searching situations it is necessary to search either by author or purchase order number. To go from one type of search to the other the operator needs only to key in the command SWITCH and press SEND. The alternate search mechanism is immediately available. This search mechanism will also allow an exact main entry search (e.g., Smith, John P.) as a search request.

The four-letter author search operates on the same multi-tiered index described by Spigai and Mahan.<sup>1</sup> The author index is an inverted tree. A title search remains to be implemented.

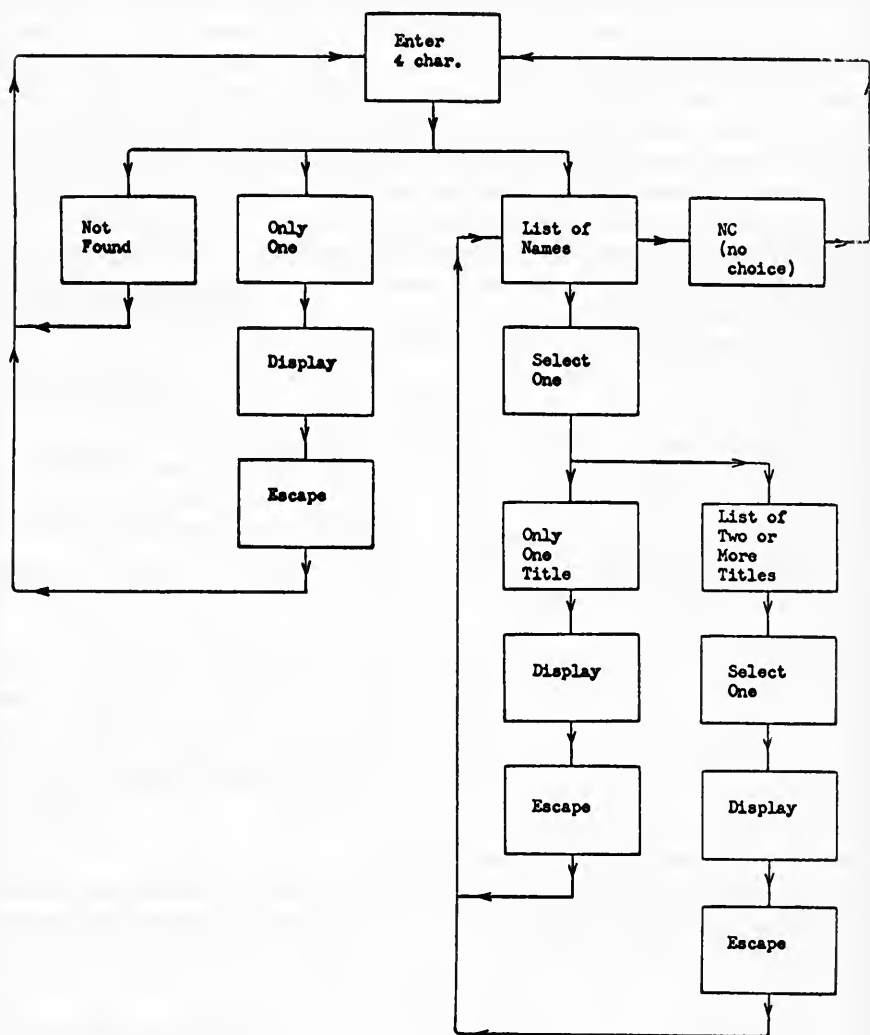


Fig. 3. Flow Chart of Author Search

### Purchase Order Printing

LOLITA was originally set up to have purchase orders printed out on a Teletype terminal located in the library. In this way there was complete control as to when the orders would be printed and control of proper forms and proper alignment of the forms. Teletype output of purchase orders requires approximately forty seconds (wall clock time) per purchase order.

This was judged to be a satisfactory method for printing orders but there was occasional inconvenience due to the length of time the teletype was tied up in merely printing. Two hundred orders at forty seconds each is one hour and forty-three minutes.

One advantage in working with the Oregon State University Computer Center is that the facilities (both hardware and software) are constantly being perfected and expanded. One expansion was an improvement in the way batch jobs could be entered remotely. It became possible to initiate the batch printing of purchase orders on the line printer from the library's Teletype terminal; so we developed an optional printing routine for line printer output.

The use of the line printer has shifted to the computer center the responsibility of loading and lining up forms. In addition to the convenience, the printing is done more rapidly and at a lower cost. The line printer prints purchase orders at the rate of about one per second; that is one-fortieth the time required with the Teletype. Two hundred purchase orders can be printed on the line printer in less than three and one-half minutes. The graph in fig. 4 shows the cost comparison between Teletype and line printer purchase order printing. Note that when printing fifty-two or fewer orders the teletype is more economical than the line printer.

As a result, although the option of printing purchase orders on the Teletype, particularly for a small rush group, is still retained, we depend almost entirely on the line printer. Our routine is to initiate the remote batch job with the Teletype, walk the short block to the computer center to pick up the printed orders, and bring them back to the library for audit, bursting, and mailing. The only problems encountered have been operator errors when the wrong forms were loaded or the alignment was not done properly. In such cases, the orders are reprinted at the computer center's expense.

### Held Orders

As mentioned, the flagword HELD signifies that the item is built into the bibliographic records for control until money is available, but that no fund accounting has been performed. Our library has had a history of substantial amounts of book fund money arriving very late in the fiscal year, sometimes on the last day of the year. To utilize these late funds it is necessary that they be encumbered and purchase orders issued by 5:00 p.m. on June 30. Therefore, we have HELD orders which, by changing the flagword to LIVE, become active purchase orders with complete fund accounting.

The first opportunity to try the HELD order procedure with LOLITA was in June 1971. Added to the book budget was \$60,000 that approximately doubled monographs and retrospective materials purchasing ability. Because we had already printed and stockpiled a substantial number of HELD orders,

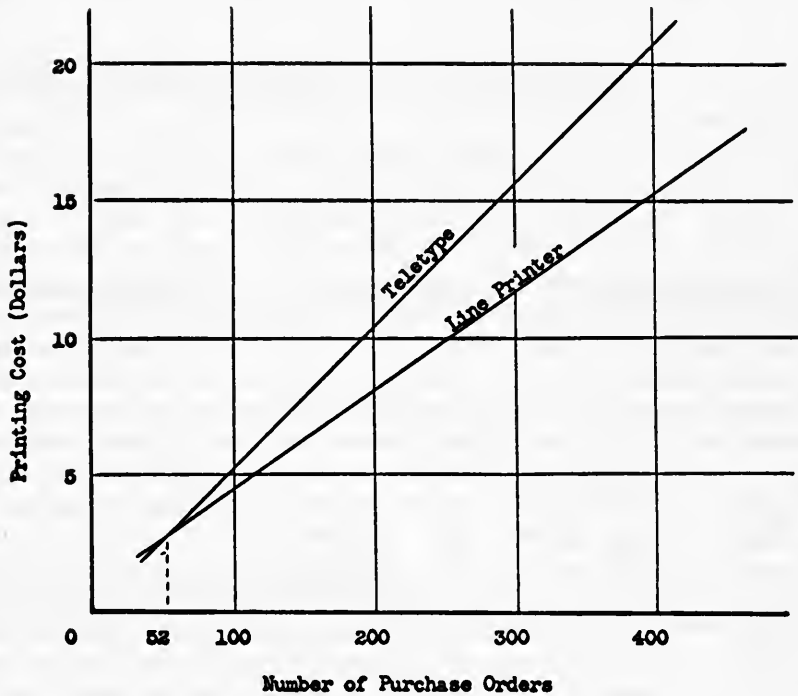


Fig. 4. Cost Comparison for Printing Purchase Orders

we were able to avoid the purchase of a major reprint set which, although composed of excellent research material, has little relevance to the Oregon State University curriculum.

As an aid in selecting from among HELD orders to be purchased, we can obtain a listing of all HELD orders arranged by fund account number, and subarranged by subject category number. Thus, we can concentrate on specific subject areas desired.

### File Structure and System Changes

The structure of the LOLITA files has undergone only two minor changes. The account number, formerly stored as two computer words, is now stored as one computer word. The position of the flagword in the sequence of data elements has been moved from fifteenth place to seventh place for easier access. Moving the flagword's position is a gradual process in which the flagword is moved automatically as the old record with the old format is accessed. This change was begun in mid-October of 1971; by May of 1972

few, if any, records are in the old format. The users of LOLITA were completely unaware of either of these changes as they were taking place.

In another area we did make a change of which the operator was aware. The first version of LOLITA filed and indexed each item as it was input. To enhance file security, the programs were altered so that as new orders are input, they accumulated in a temporary file. At logoff time or at the discretion of the operator, the contents of this temporary file are filed away and indexed. One benefit of this change is an increased rate of input since the operator need not wait for one item to be filed and indexed before the next item is input.

An on-line system operates within critical logical tolerances outside of which the computer may crash and files may be lost. When needed for back-up protection, both OS-3 and our own back-up files are used. Periodic tape copies and an item-by-item transaction file attached to LOLITA are both used. Interestingly, the more back-up capability we have developed, the less often we need to use it. This is a reflection of general improvements in the overall operating system (OS-3) and the gradual elimination of bugs in LOLITA. In fact, it is questionable whether we really need to maintain the back-up measures since they are so infrequently used; however, they are cheap and effective insurance. Thomas Mahan, research associate with the Oregon State University Computer Center, is in the process of preparing a detailed paper discussing the design, use, and need for back-up devices for use with LOLITA.

### **Program Transferability**

Many librarians have inquired about the transferability of LOLITA to their library. In answering this question, several factors must be considered. First, LOLITA is dependent on OS-3, the on-line, time-sharing operating system used by the Oregon State University Computer Center. Although there are several other CDC 3300 computers in the country, Oregon State University is the only one using OS-3 as its operating system. Therefore, only a library patronizing the Oregon State University Computer Center could use LOLITA.

Second, because of present local software and hardware limitations, a CRT terminal must be operated within 3,000 feet of the Oregon State University Computer Center. Teletype and video display terminals with Teletype logic can operate over telephone lines at any distance. Discussion among the Oregon State System of Higher Education librarians may lead to a decision to develop an alternate form of the CRT portions of LOLITA to work on a video display terminal with Teletype logic. Then any library could use LOLITA via telephone lines.

Third, there is the question of the adequacy of LOLITA for handling the book ordering and fund accounting of another library. While we had no

doubts about this, we recognized the need for empirical evidence to support our assumption. A year ago the office of the vice chancellor for administrative affairs granted us the funds necessary to support a six-month trial run with a second library. Oregon College of Education Library in Monmouth, twenty miles north of Oregon State University, participated in this experiment. Our objective was to test the adequacy of the LOLITA programs for another library, not to involve ourselves in the question of terminals and communications links. For this reason all input and updating of the files for Oregon College of Education Library has been done in the Oregon State University Library, but by persons on the Oregon College of Education payroll. As part of the experiment, the LOLITA fund accounting was to be the official fund accounting for Oregon College of Education's book, serial, and binding budget as it is for Oregon State University. The funding for what was to be a six-month experiment proved adequate to cover expenses for ten months. Oregon College of Education Library likes LOLITA, but would definitely prefer to have the input and update processing (i.e., terminals) done in their own library. Without question, the experiment has proven the transferability of the programs from one library to another within the Oregon State University Computer Center's on-line, regional terminal network.

### Dynamic Environment

LOLITA exists in a highly dynamic environment. Mention has already been made of the on-going efforts to improve the already good performance of the timeshare operating system OS-3 through software and hardware modifications.

The environment is active in other ways as well. For instance, traffic, the number of concurrent users, can vary widely according to time of day and from beginning to end of the school term. The heaviest traffic tends to fall in the mid-afternoon and after dinner hours toward the end of each term. But even traffic is not a wholly reliable indicator of one's relative ability to access the central processing unit (CPU) time. Many small jobs have no appreciable effect on overall response while a single large job may exert more competition than several dozen other jobs combined. And, of course, traffic varies widely during each particular job.

LOLITA's files vary in size reflecting a number of variables. As new data are input, whether they be new orders or invoice information, several files grow in size. As purchase order and invoice information is processed, certain transitory files grow and diminish in size. As cataloging information is added to a record, that record is released from the on-line file to be transferred to magnetic tape. The release process not only frees the file space occupied by the record, but also frees indexing and file pointer space. This free space is then available for reallocation as new information for other orders is input.

Type of Charge	OSU Computer Center Rates*	Monthly Average	Total: Jan. 1 - Dec. 31, 1971
Central processing unit	\$300/hour (\$ .083/second)	\$481.17 (1.6 hrs.)	\$5,774.00 (19.25 hrs.)
On-line disk storage	\$.15/2040 char./month	\$330.45 (4,494,120 char.)	\$3,965.40 (53,929,440 char.)
On-line terminal time	\$2.00/hour	\$228.44 (114.22 hrs.)	\$2,741.22 (1,370.61 hrs.)
CRT rental and Maintenance	\$100/month	\$100.00	\$1,200.00
Tape charge	\$.50 tape mount \$.03/sec (channel time)	\$74.99	\$899.87
Line printer	\$.125/100 lines	\$65.67 (52,539 lines)	\$788.09 (630,472 lines)
Tape rental	\$1.00/month/tape	\$13.27 (13 + tapes)	\$159.29
Card reader	\$.15/100 cards	\$.70 (465 cards)	\$8.38 (5,587 cards)
Card punch	\$.25/100 cards	\$.01	\$.16 (64 cards)
Refund		-\$83.48	-\$1,001.78
Total		\$1,211.22	\$14,534.63

\*Oregon State University Computer Center rates were extracted from the Center's *Computer Center Newsletter*, vol. 6, no. 6, Sept./Oct. 1971.

Table 3. Summary of LOLITA Charges

### Costs

So far this has been a review of LOLITA's accomplishments, changes in attitude and procedure, and a gradual reordering of our daily existence. A review of the on-going operating costs of Lolita is now in order. The operating costs billed to the library from the Oregon State University Computer Center for the period January 1 through December 31, 1971, are shown in table 3. The computer center sends the library a monthly statement containing the totals for the various services used. The figures in parentheses were computed based on computer center rates, average monthly, and total yearly costs.

Some of the tape charge represents regeneration of LOLITA's files due to computer or system failure. Some CPU, card reader, and line printer charges are also accountable to file regeneration. Whenever regeneration charges occur they are reimbursed in the form of a refund to the Computer Center Library Account. The refund also includes reimbursement for improperly printed forms because of line printer failure or computer center operator error.

The on-line terminal time represents the wall clock time the library used LOLITA either by Teletype or CRT. Based on 260 working days in a year, this averages out to 5.27 hours per day on-line. Many operations not requiring user interaction such as the preparation of purchase order forms initiated as remote jobs, the accounting, LOLITA back-ups, and preparation of outstanding order lists are performed in batch mode so no on-line terminal costs are assessed.

Occasionally an operation which is normally performed in batch mode will be performed on-line for monitoring purposes by LOLITA systems personnel to help locate a problem or in anticipation of a possible problem which, in batch mode, might cause the run to abort.

In addition to cost figures supplied by the computer center's accounting system, a logbook (LOLITA's figures) is used by the library to record unit processing information. A portion of a page of the logbook is shown in fig. 5. When a LOLITA user logs on, a status command (\*SCOOP) is entered which displays the amount of credit remaining in the computer center library account (credit), the amount of storage being utilized (SFBLKS), the number of other on-line users at that moment (traffic), the date, and the time of day. This information is entered into the logbook. Since hard copy is obtained from Teletype operations the logbook is used at the CRT only. Upon completion of a work session, \*SCOOP is again called and the new data recorded. When the user logs off, the CPU time and cost of the session are displayed and recorded. To complete the logbook entry the number of inputs, updates, or searches is recorded and initialed by the user. This logbook provides data valuable in detecting trends (e.g., peak work load periods) for most efficient scheduling as well as data necessary to compute unit operation costs. Various "time-eating" bugs have also been detected by periodic examination of this record of LOLITA's performance.

The data shown in tables 4-6, were compiled from LOLITA's figures from January through December, 1971, and from Teletype and line printer listings which contain data pertinent to the various operations. The unit cost data in table 4 were computed from samples drawn randomly from the population of data representing each particular operation. Table 5 lists information about the sample data used.

The data listed for each operation in table 4 are for an individual item. For example, to search for one main entry (line 1) would cost on the average \$.045 or to input one TF invoice (line 6) would take an average of 26.0



USER	DATE	TIME-OF-DAY		ENTRIES		SEARCHES		TRAFFIC		CPU TIME	LOGOFF COST	LAST POW OR INV#	SFBLKS(S) SFBLKS(F)	CREDIT
		LOGON	LOGOFF	PO	TF	INV	CAT	ON	OFF					
Dyana	20-Dec-71	8:16	10:22	48	—	—	—	11	25	28.358	7.36	72- 3660	2174 2191	1020.16
"	"	10:29	12:46	64	—	—	—	27	24	59.697	9.50	72- 3726	2214 2115	1022.52
Stanley	2-Dec-71	1:15	2:08	—	—	—	—	33	40	37.380	4.96	—	2115	993.63
Correne	2-Dec-71	3:25	4:47	—	231	—	—	47	27	23.522	4.66	—	2115	989.75
Dyana	30-Dec-71	3:06	10:24	74	—	—	—	12	20	52.356	9.90	72- 3800	2129 2122	789.02
"	"	10:25	1:03	39	—	115	—	20	15	80.942	11.95	72- 3839	2122 2178	974.32
Correne	31-Dec-71	1:07	2:52	—	152	—	—	14	24	15.776	4.78	—	2178	962.41
Dyana	6-Dec-71	8:00	10:03	—	4	139	—	19	41	74.574	10.17	—	2186 2208	966.85
Sandy	"	11:11	11:52	—	—	—	—	33	31	37.781	4.52	—	2208	944.83
Dyana	7-Dec-71	1:29	9:57	—	—	25	—	7	40	65.277	9.31	—	2208 2086	877.08
"	"	10:24	1:01	—	249	—	41	32	30	58.069	10.02	—	2086 2124	867.82

- Note: 1. SFBLKS are Saved File Blocks (a file block being 2040 usable characters). The number of SFBLKS in use by LOLITA at the beginning and end of each session is recorded.
2. CREDIT refers to the dollar balance held in the LOLITA production account. For convenience, the money is deposited in advance. Between Dec. 6th and 7th an additional deposit of \$7,331.25 was made.

Fig. 5. LOLITA's Figures

seconds of wall clock time. The storage increase per operation has been converted to character representation from storage units peculiar to the CDC 3300 computer and the OS-3 operating system.

Searching all new book order requests on-line began in August 1971. Although LOLITA had been operational since March 1970, a sixteen-month period was required to receive and process orders issued prior to LOLITA. In the fifty sessions (table 5) used for computing search costs, 196 duplicates were found, about four per session. The average purchase price per item is between \$12 and \$13. Thus, considering the total cost per search, \$.06 (from table 6), the identification of one duplicate pays the cost of searching 200 requests. The search sample included a session with one search which is listed in the maximum column for the breakdowns in searching (line 1, table 5). These high figures in comparison to the average (table 4) illustrate what is generally true with a complex computer system whether it be batch or on-line: as more operations are performed per session, the cost per operation decreases. When the number of operations exceed a certain point, the rate becomes nearly constant. (In fig. 4 the cost of printing orders is shown to be constant above about thirty orders. Below that point the graph would level out or curve toward the vertical axis indicating an increased cost rate for smaller batches.)

Operation	Computer cost per operation	Wall clock time per operation (in seconds)	CPU time per operation (in seconds)	Average traffic (users) for sample Storage increase per operation (in characters)	Total number of operations for the year	
1. Search for main entry	\$.045	19.9	.441	24.7	none	5.368
2. Input P.O., HELD, GIFT	.153	124.1	1.026	23.0	738	16,964
3. Prepare P.O. form file, update vendor data, P.O. accounting	.014	batch	.147	NA	494	16,964
4. Print P.O. form	.039	batch	.097	NA	none	16,964
5. Input P.O. invoice	.075	55.4	.539	20.9	218	14.403
6. Input TF invoice	.022	26.0	.092	26.1	84	9.293
7. Invoice accounting (P.O. or TF) and list invoice for audit	.0057	batch	.047	NA	128	23,696
8. Input catalog data for P.O., remove P.O. from on-order/in-process file	.114	61.8	.940	22.5	313	10,810

Table 4. Summary of Standard LOLITA Operations

The breakdown of inputs for purchase orders, HELD orders, and GIFT items (see line 2, table 4) for the 1971 calendar year was 14,428 purchase orders, 1,407 HELD orders, and 1,129 GIFT items for a total of 16,964. The addition of 738 characters per input does not indicate that the average input for this operation contains this many characters. Each new on-order file input requires 488 characters to be added to a temporary file for subsequent operations (preparing order forms, accounting, etc.). The remaining 250 characters of storage increase are also added to a temporary file for back-up purposes. Both of these temporary files are removed periodically and add little to storage costs. The data from an input does not generally change the size of the on-order file since it usually takes the place of an order which has been cataloged and removed leaving a vacant 204 character LOLITA "page." About 200 characters of the 250 characters added to the back-up file are data which were input by the user. Besides the input of data (line 2, table 4), the unit operation figures also include the storing and indexing of each item added to the on-order file.

The preparation of the purchase order form file, updating vendor information, and purchase order accounting (line 3, tables 4, 5 and 6) are accomplished by processing the input data stored on the temporary file for

Operation	Sample		Wall Clock Time (seconds)		CPU Time/Op (seconds)		Traffic		Cost/Op	
	No. of items	Ses- sions	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1. Search for main entry	4524	50	8.6	180.0	.259	5.852	10	55	\$.025	\$.590
2. Input P.O., HELD, GIFT	813	15	94.8	175.2	.673	1.497	6	41	.109	.217
3. Prepare P.O. form file, update vendor data, P.O. accounting	1312	7	BATCH	BATCH	.122	.298	NA	NA	.011	.032
4. Print P.O. form	1048	3	BATCH	BATCH	.092	.102	NA	NA	.038	.040
5. Input P.O. invoice	1029	10	42.9	94.1	.373	.740	4	34	.059	.103
6. Input TF invoice	2361	10	19.8	41.4	.072	.118	14	47	.018	.042
7. Invoice accounting (P.O. or TF) and list invoice for audit	5517	5	BATCH	BATCH	.042	.064	NA	NA	.0049	.0068
8. Input catalog data for P.O., remove P.O. from on-order/in-process file	1042	15	40.8	108.0	.671	1.270	7	42	.090	.153

Table 5. Standard LOLITA Operations: Sample Data Summary

Operation	Computer		Personnel	Total
	Unit	Annual		
1. Search for main entry	\$.045	\$241.56	\$.015	\$.060
2. Input P.O., HELD, GIFT	.153	2,595.49	.080	.233
3. Prepare P.O. form file, update vendor data, P.O. accounting	.014	237.50	none	.014
4. Print P.O. form	.039	661.60	none	.039
5. Input P.O. invoice	.075	1,080.23	.036	.111
6. Input TF invoice	.022	204.45	.016	.038
7. Invoice accounting (P.O. or TF) and list invoice for audit	.0057	135.07	none	.0057
8. Input catalog data for P.O., remove P.O. from on-order/in-process file	.114	1,232.34	.040	.154
Total		\$6,388.24		

Table 6. Summary of Computer and Personnel Unit Costs for LOLITA

this purpose. The 494 characters added to storage by this operation are broken down to an average of 446 characters per purchase order form and forty-eight characters of individual purchase order accounting data. When the purchase order forms have been printed, the 446 characters of storage per form are released. The forty-eight characters per purchase order stored for purchase order accounting are accumulated over a month's time, listed for the bookkeeper's easy reference and transferred to magnetic tape. The on-line storage for this temporary purchase order accounting data file is then released. The traffic for batch operations has not been obtained since the increased duration of a batch job caused by the amount of traffic has little effect on the cost of the operation.

The operational figures for updating the on-order file by inputting invoice data are given in line 5 of tables 4, 5 and 6. This update usually includes the addition of the following data elements: flagword, actual amount (in dollars), invoice date, and invoice number. The order to be updated is accessed by the purchase order number which most vendors list on their invoices. The appropriate data (84 characters) are transferred to a temporary file as a source for a subsequent accounting operation. The remaining storage increase caused by purchase order invoice input is the new data being entered on a back-up file.

As in the case of a new purchase order input, the added invoice data stored in the main file do not increase long-term storage.

Invoice data for material received on a standing order basis (TF, 'til forbidden) are input for accounting purposes using TFINVO which was described above. Operating data for TFINVO are shown in line 6 of tables 4, 5, and 6. The eighty-four characters of increased storage represent the transfer of data to the temporary TF accounting data file.

The accounting using the invoice input for purchase orders or TFs is performed by the same program (PREPARE) that prepares purchase order forms. If the program is run on-line only purchase order data are manipulated; no invoice accounting is performed. The program is set to run in this manner to accommodate the preparation of RUSH orders or a small batch of orders. The LOLITA user continues to interact with the system so that knowledge of when the purchase order forms may be printed will be immediately available and printing may commence at the library on the Teletype without requiring a trip to the computer center. By not performing invoice accounting on-line, terminal and user time is saved as well. When PREPARE is run in the batch mode the invoices are processed. The operating data for this process are shown in line 7 to tables 4, 5 and 6. The 128-character per invoice storage increase represents invoice data being stored on a temporary file. This temporary file accumulates invoice transactions for a month and, at a cut-off date, is sorted and listed in a manner similar to the forthcoming controller's list of the checks written for these invoices. The controller's list is compared with the library monthly invoice list to verify the check writing. The processing of the invoices also produces an invoice audit listing. This audit listing is given to the bookkeeper with the invoices to verify that the invoices have been input correctly.

Once a book is put onto the shelf and represented in the main card catalog, a copy of the master catalog card is used to update the on-line order for that book. The data for this catalog data input are shown in line 8 of tables 4, 5 and 6. Any bibliographic data stored on-line which is different from the catalog copy is edited at this time. The LC classification number and date cataloged are also added to the on-line record. This triggers a mechanism which removes the record from the on-order main file and index files. The item is written onto a temporary file which is used to produce "Additions," the library's bi-monthly announcement of new materials added to the library collection. When "Additions" has been produced, the file of cataloged items is copied onto magnetic tape for possible future use.

On-line operations (lines 1, 2, 5, 6, and 8 of tables 4, 5 and 6) are affected by the number of computer users. A LOLITA user will not normally detect a delay in response until there are more than thirty other users on the system. Usually computer traffic only affects LOLITA's response during the last week of the term when student programs are due. Revisions to the

computer center system (OS-3) have enabled more users to operate more efficiently than in the past.

The operations in tables 4, 5 and 6 account for \$6,388.24 (the sum of computer costs, annual column, table 6) or 44 percent of the \$14,534.63 paid to the computer center for services during 1971. These operational costs do not include on-line disk storage (\$3,965.40), CRT rental (\$1,200.00), or tape rental (\$159.29). Adding these figures to the operational sum gives a total of \$11,712.93 or 80.6 percent. The remaining \$2,821.70 has not been separately identified but has included the following:

1. The preparation and listing of five issues of "Additions." Each issue contained an average of 1,826 items which were added to the library collection.
2. Two productions of lists containing the orders of the on-order/in-process file which had not received invoices (i.e., were outstanding). The first list was used to establish a hard copy record of orders which would not be processed (invoiced) during the fiscal year of the order, and the second was produced to be used as a claims notice to vendors for items which had not been received. Each list required an examination of all records in the on-order file which is stabilized at about 6,000 items.
3. The preparation of accounting summary statements. This summary contains six pages of accounting information including: allocations, expenditures, encumbrances, balances, last purchase order posted, and last invoice posted for about forty budget lines; a category summary of expenditures and encumbrances for nine different groups of over ninety categories each; the amount of money in HELD orders which exist in the on-order file; the GIFT evaluation to date; and the status of purchase orders, HELDS, and GIFTS. These statements are prepared at least weekly and cost about \$.75 each.
4. The on-line examination of accounting data which is done irregularly to determine accounting status between accounting summary statements.
5. The on-line manipulation of on-line accounting data to correct for a change in budgets or an error in the manual processing before invoice input (e.g., assignment of a wrong TF account number).
6. The operation of on-line auxiliary programs which include status programs for purchase order preparation or invoice preparation (NOPO and NOIN) and programs which release temporary files after verification of processing (POOK, INVOK, MONTHOK).
7. The on-line vendor file updates, maintained for the over 2,000 vendors being used, which include: adding new vendors, changing existing data, deleting vendors, adding temporary vendors, and changing frequency or dollar amount.

8. The preparation of two vendor status listings which include names and addresses of on-line vendors plus the frequency and amount of money paid to each vendor.

These operations are executed irregularly with the exception of the on-line vendor file updates, which are usually done before each invoice accounting run. This file is being examined for possible changes to accommodate multiple school usage and the inclusion of additional data elements to lighten the invoice handling by library and controller's office personnel. The program involving vendor file updates would also need to be changed; therefore cost data for this operation have been omitted.

This discussion of LOLITA and her operating costs has centered primarily around computer costs and procedural changes. Personnel costs are discussed only briefly and shown in table 6 for five on-line operations. The library also employs one systems analyst who spends part of his time with LOLITA and a research associate who spends about 25 percent of his time with LOLITA revisions and operations. Non-LOLITA aspects of the Oregon State University Library's operations have been intentionally ignored, not because they lack importance, but because of a basic commonality with most other academic libraries.

This paper has attempted to give an overview of LOLITA during the past two years; two or three years from now may show differences. A written proposal to the chancellor's office is pending which would extend LOLITA to the other libraries in the Oregon State System of Higher Education. There is also discussion of developing a serials control capability for LOLITA.

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## On-Line Technology in a Library Network

### ADVANTAGES OF ON-LINE SYSTEMS

The advantages of computers in libraries, although not a supposition which one can afford to accept blindly, are as real as the advantages gained from the other pieces of mechanical equipment which have become everyday tools for accomplishing libraries' objectives. A major difference, however, is that a library's investment in computers, attendant staff, supplies, etc., is so much greater in terms of time, money, and energy, and in general commitment to examine minutely the operations the computer is to perform, that the comparison with other machines seems less valid. It is not a crisis if a system planned around a tape-operated typewriter does not work and one is forced to return to a more traditional method. The situations are similar in that it is not necessarily the technology at fault, but perhaps the technique. One might call the problem "The fault, dear Brutus, . . . syndrome."

The problems which many libraries have had with mechanization become magnified greatly when they begin to work with on-line systems where the stakes involved in success or failure are higher. No one claims that everything ought to be done with machines, and there is no reason to suppose that a combination of manual and mechanical, on-line and off-line systems will not serve the library better than any one type of operation by itself.

On-line technology offers an unparalleled opportunity to accomplish many of the things which libraries have always said they would like to if they had the opportunity. Now there is the chance not only to catch up with the flood



of information pouring into the library, but even to turn some of the flood to advantage and, of course, to the benefit of users.

The library has been viewed as a total system for years, and many have dogmatized that this approach was the only rational one to take in library automation. There is, however, no reason why all of the parts of the system must be developed simultaneously. The valid approaches are many and varied, and more important, there are many approaches which have worked—a success that library automation efforts have not always achieved. The literature is filled with lavish descriptions of planned systems replete with glowing estimates of what they will accomplish, but the search must be long and hard to find reports that these efforts have been successful. One searches in vain for reports that a previously well-publicized system has failed. The expenditure that has gone into abortive system development is scarcely credible and certainly not creditable to the profession. Even the documented reports of failure would have, perhaps, helped someone else.

Why, then, is there an emphasis on on-line systems, which not only cost a great deal more than off-line systems, but are vastly more complicated to organize and place in operation. The answer lies in societal needs and expectations. We expect things to be fast, we equate speed with machines, we believe that quality is inherent, and we assume that speedy machines are efficient (although with the example set by Detroit for the production of defective machines, one does tend to wonder at the credulity of people).

On-line technology will make the development of a national or regional library network a real possibility. On-line systems will enable us to learn more quickly, to alter our behavior patterns accordingly, and thus, to advance the sum of human experience and the quality of life.

The main purpose of on-line technology in a library is to better serve the user, which is after all a library's main purpose for existing. Few libraries today see their major role as custodians of the past for the benefit of future generations. On the contrary, all that we do should improve our service capabilities to the person seeking information now. On-line technology not only allows services to be provided more quickly, but for the first time allows the library to disregard the limitations of its physical structure and interact with users at other sites, and at times of their own choosing. We thus begin to approach the goal of making a library available to users on a twenty-four hour basis with few of the attendant costs of maintaining a physical facility or providing large numbers of personnel. On-line technology allows us exploitation of limited resources of people, money, and information more effectively. On-line technology also frees users from many of the cumbersome restraints which libraries interposed between them and their needs in the past, forcing them to adapt to the internal operations of the library rather than vice versa.

In discussions of on-line technology, most still think in terms of the familiar computers and the adjunct hardware, but it is already evident that

this is too narrow an approach to the subject. Other elements of technology which complement the computer must be considered. Libraries have not really considered the possibility of cable television as a major tool to serve them in their role as important educational elements in their community, whether public or university. Users should be able to call the library from their homes, select programs from a printed catalog, and request that they be sent via the phone line for playback through television equipment. Home videotape cameras for making home movies, recording programs from television broadcasts for later playback, purchasable cassette programs and a modified television receiver to accept them are already on sale in Chicago. If the current test marketing proves successful, it may be assumed that an extensive national sales campaign will follow.

Few libraries have made computers available to users to solve problems of their own. Not until recently has there been the possibility of using the coin-operated, self-service computer terminal at \$0.25 for five minutes of computer time.

There are other possibilities which libraries will need to be aware of and which will radically alter the services and collections of libraries. What holographs and lasers will produce and provide has hardly begun to be explored.

On-line technology therefore provides the library with a powerful tool to enable it to do new things and to perform many of its present operations in new and better ways.

## USES OF ON-LINE SYSTEMS

### Interlibrary Loan

An example of the possible power of an on-line network involves the interlibrary loan process. The term "possible power" is used because the problems involved in placing it in operation are not technological.

The data base in the State University of New York (SUNY) network (fig. 1) consists of citations to journal articles, citations to books, and a union list of serial titles with holdings statements and location information for those titles which are represented in the journal citation file. Therefore all information regarding citations which is necessary for interlibrary loan is available. The user, after obtaining the output to his search and scanning the retrieved titles for relevance, indicates which citations he wishes to see. If the user is in the library where a citation is located, he is given any necessary information to retrieve the document, i.e., call number, shelf title or special location.

The SUNY system was originally planned to include all circulation records for each member station, and, in that case, the circulation files would also have been checked to determine whether the item was out or otherwise unavailable, in which case a request would have been placed on the record for

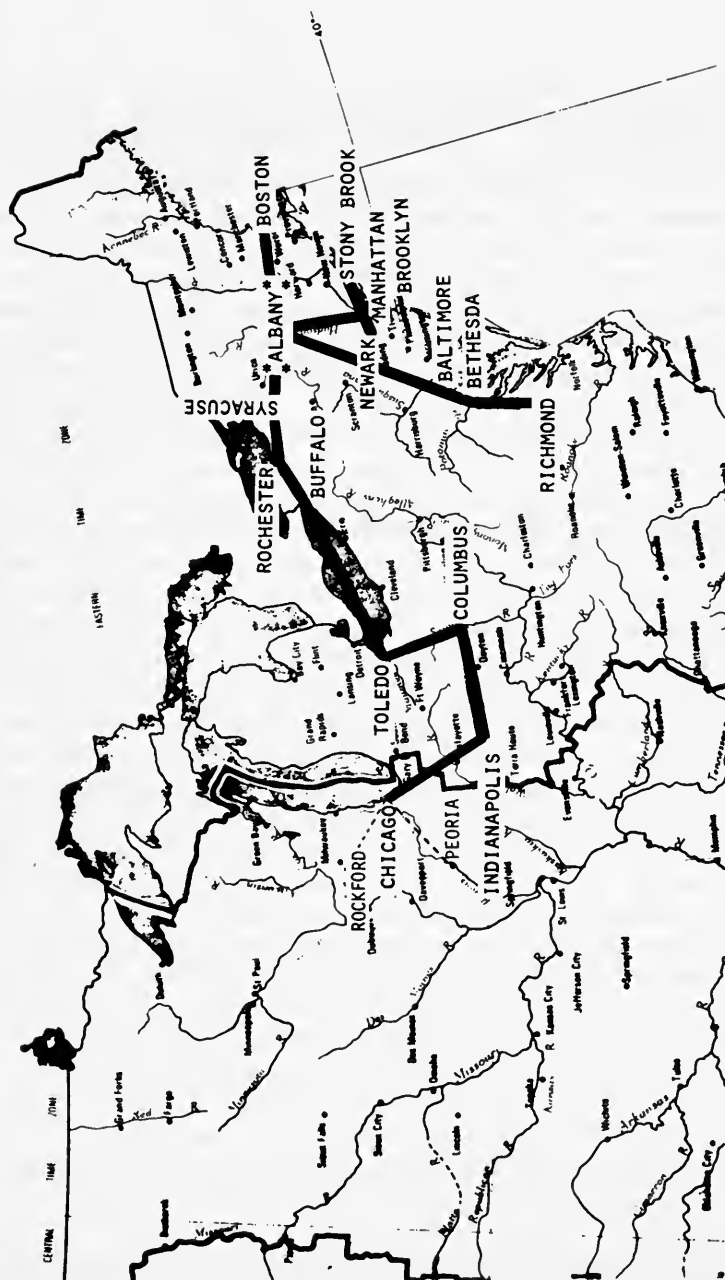


Fig. 1. SUNY Biomedical Communication Network as of March 1972

the user. For items which were not owned by the user's library an interlibrary loan request in standard telecommunications format was to have been sent automatically to the nearest network station which was able to supply the item; a duplicate copy of that request would have been generated in the interlibrary loan office of the user's library. Prior to this the user was to have been given the opportunity to reject the interlibrary loan segment of the service for each selected citation.

This service, therefore, tied together the cataloging aspects of the system, circulation, and serials control, and added the journal article citation data from an external source. This type of service begins to approach the "total system" goal toward which libraries have been striving. It eliminates a number of steps for both the user and the library. Gone is the need for the user to copy down his citation from the secondary source and to recopy the citation on an internal interlibrary loan request form after he has determined that his library does not have the item. The library's need to verify the citation has been eliminated since it has come from a verified source and has not been transcribed which might have introduced errors or diluted information content. The step of retyping the verified citation with the attendant possibility of additional clerical error in this third transcription is also removed. In addition, the delays attendant upon these processes within the library are reduced, together with the major delay caused by mailing the request to a library which may be able to supply. It should be noted that since the computer system has already verified the source of supply, the delays caused by repeated efforts to obtain items from libraries which cannot supply are minimized. The net result of this chain of events is a marked increase in the speed of delivery of the document to the requester, a document which will be even more rapidly supplied if telefacsimile equipment is employed.

This entire process is not a complicated one, and it does not depend on new technology, major reorganization of library functions, or large increases in library budgets. The SUNY network performed all of the necessary programming and testing of the required procedures, and the entire system was declared operable in 1969. At that point, the problems which face a library network, but which are unrelated to its technology, became evident. As the librarians of the member institutions were faced with the reality of accepting a larger number of interlibrary loan requests than they had been accustomed to receiving, they balked. The Network Advisory Council felt that the anticipated avalanche of requests would render normal service in this area unworkable, thus the automatic interlibrary loan procedure was never tried, even on a limited basis.

Another use of the bibliographic data base described above is in the verification of requests for interlibrary loan which are not generated through

computer search. Using search options like "title scan," it is possible to verify citations which may be incomplete or only partially accurate. It is not possible to perform an author search of the MEDLARS file on either the SUNY or MEDLINE systems at the present time, although this disadvantage is not as serious as it would be without the printed *Index Medicus* author index at hand.

### Multiple Data Bases

One of the principal benefits which can be justifiably expected from computer systems is that which derives from their ability to do repetitive jobs quickly, accurately, and with a minimum of human intervention. Libraries have looked forward to the day when a number of secondary sources could be searched with a single command or search strategy (single in the sense that it needs input only once). Also anticipated was the ability to progress along levels of information in a sequential fashion, depending on the results of the preceding portion of our search. The SUNY network stated this type of search capability as a phase two goal when it was planned in 1966, and the University of Chicago has recently restated that this type of activity is one of its continuing (although unfunded) goals.

When it is considered what could be achieved for the library user by searching a combination of the data bases available in machine-readable form from *Chemical Abstracts*, *Biological Abstracts*, *Excerpta Medica*, *Science Citation Index*, *Index Medicus*, and a number of other automated publications, it is apparent how far there is to go in on-line or off-line information retrieval, even before the millenium when full texts of documents can be retrieved. If these services were correlated so that the searcher could locate first the bibliographic information, and then the abstracts of articles which he selected, a new level of user service would have definitely been achieved.

Although the SUNY network is not yet approaching this kind of service capability, it is about to begin an experiment which may finally lead to such an on-line data base. For an experimental period of four months, SUNY will load 50,000 citations from the 1971 files of the *Drug Literature Index (DLI)*, published by the Excerpta Medica Foundation. This tool is a hybrid, appearing to be a cross between the bibliographic index and the abstracting service, in that it combines the citation with what might be called a telegraphic abstract comprised of a number of thesaural terms. The *DLI* provides indexes by drug class, generic name, trade name, author, and a separate listing of new drugs. The citations are somewhat different than those of many other indexes in that the foreign-language titles are first given in English translation, followed by the affiliations of the authors. See Appendix at end of chapter for additional information.

The indexing terms used are from a controlled vocabulary called MALIMET (Master List of Medical Indexing Terms), but the *DLI* also uses what it calls secondary indexing terms. MALIMET consists of some 40,000 preferred terms together with *see also* references and up to five class assignments which indicate biomedical fields, subjects areas, or disciplines. In addition to the primary or preferred terms, there are approximately 500,000 synonyms which are also keyed to the primary related term. These secondary terms are not those which would normally be used to look up an article but which provide information as to the nature of a given investigation (e.g., anatomical, demographic, or electrophysiological study), the species of experimental animal used, the type of primary document (e.g., review, textbook, etc.) or even quantitative data on the scope of the study and the value of the results (e.g., nineteen patients, result). The sources of the citations are 3,400 biomedical journals appearing worldwide, and each monthly index contains about 4,000 citations. The price of this service (\$2,000 a year for the twelve monthly issues including two semiannual cumulations) makes it prohibitive for most libraries, but the use of the data in a cooperative network brings the information to a number of locations which could not individually afford to obtain it.

Using the STAIRS operating system developed by IBM, the SUNY network will permit the user to search the file either through the controlled vocabulary or by the use of the secondary, natural language, terms. The internal indexes are constructed as a series of inverted files, and the computer retrieves the citation only after all of the search parameters have been satisfied. This experiment will be monitored closely and evaluated, and the use of the file will be studied by an outside (non-SUNY or network) research team. If this test is successful, the network plans to make available a two-year file of the *Excerpta Medica*, now published in thirty-nine monthly subject sections, which will also be searchable using the controlled vocabulary or natural language. *Excerpta Medica* abstracts are English-language summaries, not telegraphic lists of subject headings. This data base would contain 500,000 citations, and the abstract words would be arranged internally in inverted files.

The recent *UNISIST Study Report on the Feasibility of a World Science Information System* noted the parallel development of MEDLARS and the *Excerpta Medica* systems and then called for the coordination of the two services in this area in which they closely overlap. Both of the parent organizations have agreed to adopt a common communication format to facilitate the exchange of data and the possible interconnection of the two systems.

SUNY			MEDLINE		
	Citations	Dates		Citations	Date
Medlars files			Medlars files		1969–
on-line	645,378	Oct. 1967-June 1972	on-line	400,000	June 1972
off-line	1,043,114	1964-1969			
NLM book	48,000	1968-1971			
NETBOOK	15,890	1962-1970			
DLI	50,000	1971			
Total on-line file	759,268				

Table 1. SUNY-MEDLINE Data Bases

### Multiple Networks

A valid often-raised question concerns the benefit or necessity of having two networks in existence such as MEDLINE and SUNY. Why should a library pay SUNY \$8,000 to \$10,000 a year when it could participate in the MEDLINE network for the cost of a TWX terminal, which it may already be using? The major reason is that the two networks do not duplicate each other at the present time, and each can do some things that the other cannot. This gives additional power to the library which is able to employ both systems, allows it to provide more services, and, of course, doubles the access of its users to the available data bases. Even as MEDLINE adds additional data bases such as the NLMBOOK files, the networks will not necessarily converge (table 1). Each plans new services and the things that each system is able to do will continue to differ because of the internal operating systems which have been selected. The SUNY Network Advisory Committee has urged the network to select a different type of system for its operation because of the potential that results from testing different methods of doing things, a legitimate function of a university and a capability which might well have been lost were the SUNY network to have turned into a back-up MEDLINE operation. As evidenced by the forthcoming work with the *Excerpta Medica* data bases, the need for a viable alternative system exists and would benefit the profession in many ways.

An unresolved problem of on-line systems which does depend on their technology is that which arises when more and more people attempt to use the system simultaneously. A graph produced by the National Library of Medicine (NLM) shows clearly that an important drop in response time occurs when the number of simultaneous users rises from forty-five to fifty-five (fig. 2). Considering that there are at least 100 users—some of whom are shown with their use figures in table 2—who constitute NLM's primary population

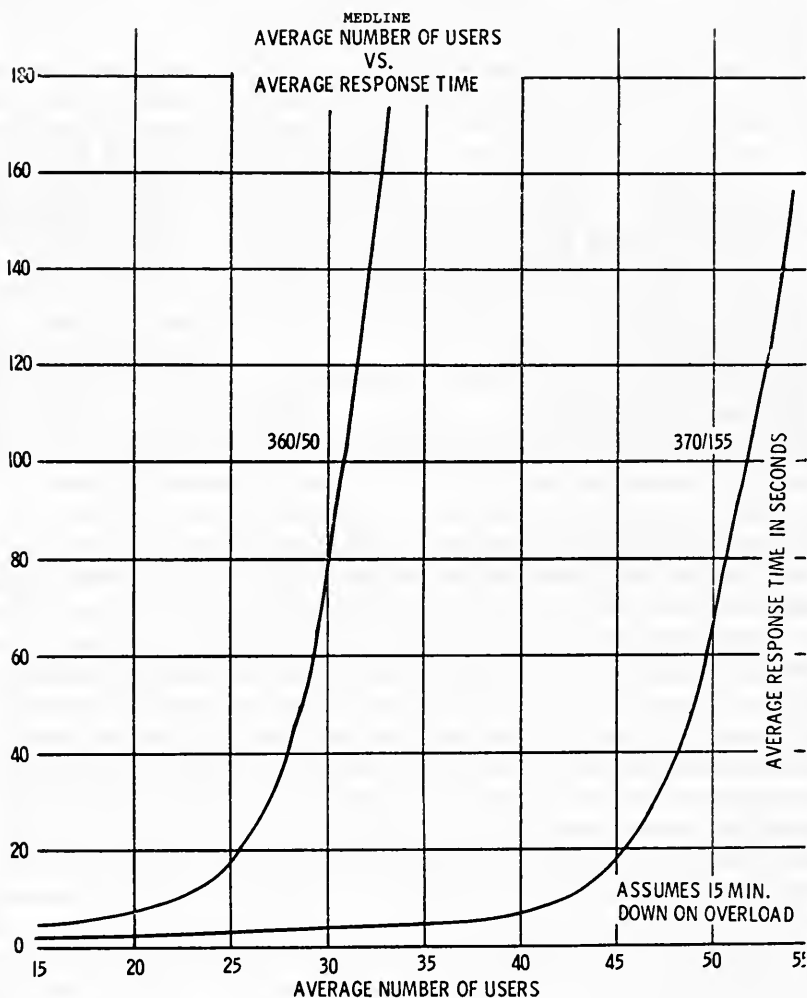


Fig. 2. How Number of Users Affects Response Time

(including the medical schools and the regional medical libraries), and that there are plans for extending the service to secondary sites such as hospitals, this is an important factor to consider. Increases in search activity are shown in figs. 3 and 4.

Although the difference between a response time of 20 seconds and 160 seconds may not appear to be great, if we were to stop and wait for those 160 seconds to pass it would begin to seem interminable. To the user seated



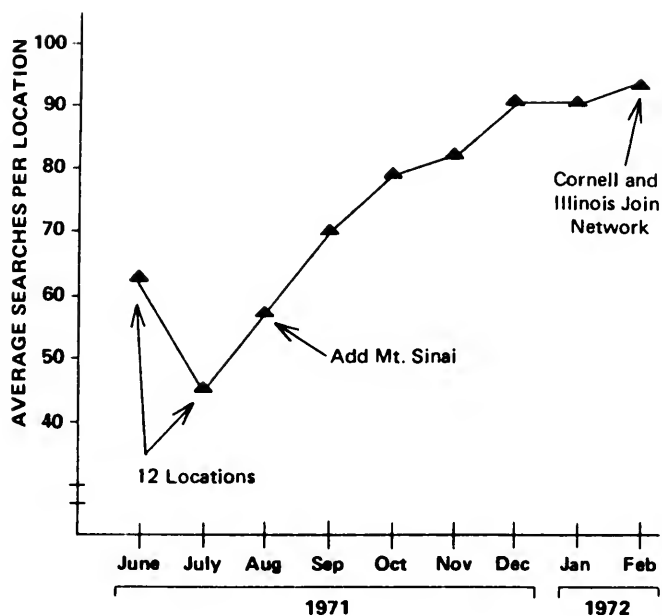


Fig. 3. Average Monthly Searching Activity

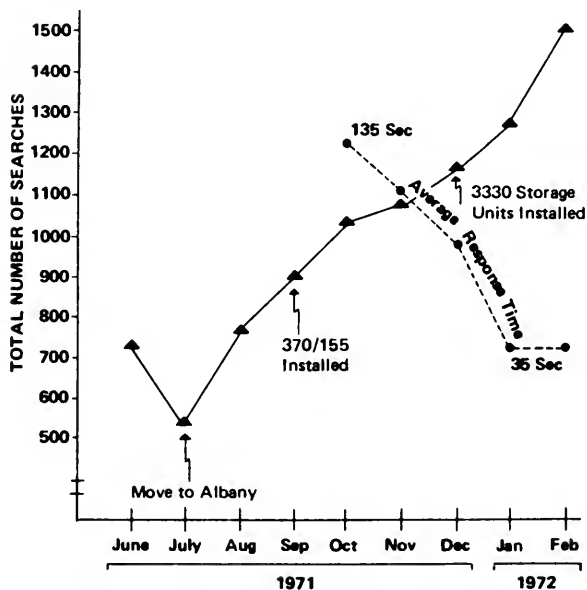


Fig. 4. Total Monthly Searching Activity

Terminal	Completed Searches										
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	
*02 Food and Drug Administration											
03 Upstate Medical Center	101	70	66	130	112	94	97	60† 140	60† 185	28 170	
04 "											
*05 Medical College of Ohio, Toledo											
06 University of Rochester	50	62	64	54	77	59	97	37	72	97	
07 Indiana University Medical Center	39	36	54	85	80	91	92	85	79	77	
08 SUNY at Buffalo	102	72	113	182	227	218	207	231	260	122	
09 "										255	
10 "											
11 Albany Medical College	69	33	65	79	87	76	67	103	100	75	
**12 National Library of Medicine											
**13 National Library of Medicine	76+	6+	25+	41+	37+	139+	253+	475+	388+	75	
14 Ohio State University	29	20	31	35	67	65	44	55	65	62	
15 Downstate Medical Center	11	12	5	21	18	23	31	11	23	27	
16 College of Med & Dent of NJ, Newark	65	40	73	56	59	126	130	110	92	144	
18 Countway Library of Medicine	25	26	33	36	32	36	50	57	71	83	
19 Medical College of Virginia	99	52	76	44	66	63	95	87	83	115	
***20 New York State Medical Library											
*****21 SUNY at Stony Brook											
22 Cornell University Medical College	60	36	60	62	76	83	113	121	109	77	
23 Johns Hopkins University	74	81	90	84	96	90	95	99	143	140	
*****24 US Army Medical R & D											
25 Mount Sinai Hospital			18	30	32	44	65	45	43	68	
26 Cornell University Life Sciences									60	79	
27 University of Illinois, Chicago									25	66	
Total	724	540	748	898	1029	1068	1183	1275	1513	1760	

† not included in totals

\* incomplete

\*\* terminal not used for "searching"

\*\*\* no data available

Table 2. Some SUNY Biomedical Communication Network Users and Their Searches

at a computer terminal, who knows that there is a powerful device connected to his station which operates at electronic speeds, a delay of 160 seconds becomes intolerable. We learned very early that the threshold of user impatience when using an on-line system is very low. One can choose to ignore the problem, but one then finds that the system is regarded as unsatisfactory by many, and ignored altogether by others. Driving away the potential user is not the solution to the problem.

NLM postulates that there may be a need for shifts during which groups of terminals are authorized to use the system; this method of expanding the capacity of the SUNY system was also considered. SUNY has not yet, however, had to face the problem because their terminals still number less than thirty. The system designer must also consider that when the system overloads and fails, it may require fifteen minutes to restore the programs and enable searching to resume. If this happens with any frequency, not only is one faced with the problem of user dissatisfaction, but also with what happens to the data which were being transferred at that time. When dealing with a system other than searching from a file, that is, when entering new data to the system, one does not know, for example, which circulation records were lost when the system dropped without going back and redoing a certain number of transactions at each terminal location—a difficult task if the user's ID card is required as well as the book card, and the user has already left the circulation area. When one is dealing with internal library operations, the problem may be tedious, but no more than that; when the user is involved, however, the problem is far more complicated.

### CASE and CRIB

The Library of the Health Sciences now has four on-line systems combining a variety of functions and services available for use by the patron. The systems are the SUNY Biomedical Communication Network, the National Library of Medicine's MEDLINE (MEDLARS On-Line) Network, and the University of Illinois at the Medical Center's CASE (Computer Assisted Simulation of the Clinical Encounter) and CRIB (Computer Randomized Item Bank) systems.

CASE is a unique program which enables the medical student or practitioner wishing to review or test a course of action to select a case study in a particular area from the series available (emergency orthopedics, obstetrics and gynecology, pediatrics, psychiatry, and internal medicine) and proceed with analysis of the problem, diagnosis and treatment. The program provides an introductory description of the patient and other related information and the physician is then able to ask the patient (i.e., the computer) questions, order laboratory tests and review the results, obtain physical information and any other data which he deems significant. After this stage is complete and the physician feels that he understands the case and is ready to proceed, he

then enters his own diagnosis and treatment of the case. After this is done, he receives the author's diagnosis and treatment plan, and is told what happened to the patient as a result of the course of treatment he prescribed. The system also supplies a list of critical concepts relating to the case which should have been explored and notes whether the physician covered them or not. The user may terminate his interaction with the system at any time by typing the word "quit."

CRIB is a system designed to allow a student to test himself in a subject to determine his grasp of the material as well as to instruct himself. The subject areas covered by CRIB are: anatomy, dermatology, microbiology, physiology, pathology, histology, pharmacology, medicine and orthopedics. The questions are in multiple choice form and the student is credited with only his first answer, i.e., he cannot change his mind on a particular question after answering it. He can then request the correct answer by typing the word "answer" to see if he was correct. He can skip questions in a series, or terminate his test at any time. The system maintains a record which is available only to the student, so that he can see how he scored on the question group. The system uses a Hazeltine 2000 Cathode Ray Terminal which is connected to the computer using an acoustical coupler and a voice grade telephone line. There are eleven terminals now connected to the system including those in the library's branches in Peoria and Urbana. Terminal access will also be provided in the branch library in Rockford in 1972 when the first class is admitted.

Plans are also underway for the CASE system to be used through the National Library of Medicine's Biomedical Communications Network using the TYMNET circuits (also used by MEDLINE).

### Coordinated Staffing

An intriguing area of networking in an on-line mode is that involving the sharing of professional resources. Although this is basically an uncomplicated concept, it is one which has not been applied in an organized program.

By coordinating staffing patterns, the various stations in a network would be able to provide professional service over a broader range of hours of operation than any one of them could provide alone. In this way, weekend and evening hours, which are usually considered disadvantaged shifts by most staff members, could be distributed among a large group of people. It does not, of course, require a computer system to achieve this type of program. A coordinated staff sharing program can be developed using telephone lines, and the Library of the Health Sciences will be testing the effectiveness of this program using both telephone lines for direct calls to Chicago when a professional staff member is unavailable in Peoria, and the SUNY terminal, using the computer as a message switching device. One convenient feature of the

computer message is that if an addressed terminal is busy, the computer stores the message and transmits it as soon as it can capture the terminal. Messages show the time of input as well as the time of delivery.

A major problem with this type of service is the human problem of convincing the user to pick up the phone to make the call for assistance, or getting him to sit down and type his message. The use of Picturephone may well be an added inducement to the user to try such a service, and it has the advantage of making the program more personal. Another important feature of Picturephone service is that it enables the professional to place printed copy on the screen for the user to either read quickly or note and removes the disadvantage of much telephone reference work which results from the reading of sections of a book to answer the question. This combination of graphic display and two-way verbal communication has not yet been exploited by libraries; it will be interesting to see what the impact of such service will be.

## STANDARDIZATION

One would be remiss in discussing network technology without at least mentioning the importance of standardization. The small differences in the ways libraries have recorded information and what information they have required have caused innumerable problems in the development of national data bases. The efforts which went into the establishment of the MARC format were monumental, and the agreement of libraries to use MARC as a communication format has been relatively slow in gaining wide acceptance. The fact that all of the major national library associations have endorsed this policy seems to have made little if any difference. The significance of the term "communication format" should not be lost, for libraries are asked to standardize not their internal systems, for which needs differ considerably, but only to provide a common format which will enable the data captured at one location to be used at another. This means, in effect, that each library or computer center need write only one program to convert its data into the standard format and one program to convert MARC format tapes to its internal processing format.

That standardization should be difficult for libraries is a little strange, since many libraries have standardized their subject heading lists and classification systems by basing their work on the most common U.S. systems available. But the implied loss of autonomy which standardization means has caused many libraries to resist, and has hindered progress toward a national network or even toward regional centers.

Nonetheless, networks imply a degree of standardization in both the input to the system, and the techniques used in querying the system. It would seem preferable to be found in the vanguard of such a movement and to assist in

the development of standards, than to be caught in the rear where one may be forced to adopt them for sheer survival.

On-line technology is the tool which will enable libraries to meet the challenge of providing information services to their constituencies in the 1970s, and it is the greatest hope that libraries have for establishing a relevant relationship with their users.

## APPENDIX

By mid-summer of 1972 the SUNY network had decided not to use the *DLI* for a test data base, but instead to work with the *Excerpta Medica* files.

Plans were made to prepare two to three months of the entire data base of the thirty-nine sections of *Excerpta Medica* for searching in an on-line mode. Four test centers were selected, John Hopkins Medical Center Library, the Francis A. Countway Library of Medicine (Harvard), the SUNY Upstate Medical Center Library, and the University of Illinois Library of the Health Sciences.

The network will conduct a comparative evaluative test using both free text and controlled vocabulary searching on the *Excerpta Medica* file, and using controlled vocabulary searching on the MEDLARS file. Each test center will initiate approximately forty searches and the resultant 160 searches will be performed in each center. After the evaluation of the test data, it is expected that the entire *Excerpta Medica* file for the most recent two-year period will be loaded into the system and made available to all network stations.

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Los Angeles, California

## On-Line Serials Control at UCLA\*

The Biomedical Library at UCLA is the primary library for the UCLA Center for the Health Sciences, which includes the Schools of Medicine, Dentistry, Nursing and Public Health, the hospitals, clinics and institutes, and the Life Sciences Division. The center is one of the largest teaching and research centers of its type. In 1971 it retained 589 full-time and part-time faculty, 505 postdoctoral and full-time research appointees, and a support staff of more than 2,500 administrative, technical, clerical and other personnel.

An important ancillary division within the center is the Health Sciences Computer Facility (HSCF) which has as its primary goal the furtherance of biomedical research through the development of the mathematical and statistical methods and the data handling facilities required to enhance such research. One of the most significant products of the facility's interest in developing new uses for its computer is the Terminal Oriented Real-Time Operating System (TORTOS) which allows its user community remote access to the computer via terminals. The computer used by the facility is a large IBM machine, the 360 model 91.

Within the framework of its environment at the Center for the Health Sciences, the Biomedical Library carries out its objectives of supporting the teaching, research and service functions of the center. The library has approximately 6,500 regular users, chiefly faculty, students and research staff of the schools and departments mentioned. In addition, in the interest of the service

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function of the university, the library extends its services to affiliated hospitals and the local health sciences community. Through the extramurally supported Pacific Southwest Regional Medical Library Service and other projects, it provides a variety of subregional, regional, national and international services. One example of this service is the library's handling of some 3,000 interlibrary loan requests per month through the Regional Medical Library Program.

As is generally the case with libraries in the physical and life sciences fields, particularly in research-oriented institutions, journals and periodicals are the mainstay of the library services. In order to adequately cover the scope and range of materials required by the service function, the library maintains subscriptions to about 6,500 journals. The goal is to collect all important materials within scope which are published throughout the world.

Recognizing the potential of automation to handle the large quantities of data entailed by our periodical operations, we became one of the first libraries to enlist the use of the computer to manage our files of journal information when the initial efforts at systems design and programming were begun in 1963. By 1966 a machine-readable file had been prepared and initial listing and updating capabilities were operational. By the end of 1969 we had developed an integrated card and tape oriented batch process system to handle our check-in, claiming, and binding operations, and in that year published our first annual serials holdings list in conjunction with the Regional Medical Library operations.

A brief description of the batch processing system will provide the necessary background for a description of the on-line system which has now replaced it. The following figures provide an idea of the activity involved in the batch system: about 150 journals arrived each day to be checked in; every other week over 400 completed volumes were sent to the bindery to be bound; and as many as 100 computer-produced claim letters were processed weekly. New entries due to new subscriptions or changed titles averaged about 12 per week; other changes or additions to existing records averaged several hundred per week. In summary, each week at least 15 percent of the records in the file were altered or updated in some way.

All updates of the type just mentioned were made via punched cards sent into the computer once a week. In addition to the programmer who worked about half time at maintaining and supervising the system, two library assistants working exclusively at the coding, keypunching and other card handling aspects of the system were required to process the work. It should be pointed out that at least one of these two and probably both would in any case have been required to put the manual system into optimum condition and to process the claiming backlog of many years standing.

Against the computer and equipment costs of \$7,542, and the half time programmer salary of \$6,000, or a total of \$13,542 per year cost, about



\$15,950 of benefits resulting mainly from increased efficiencies of operation have been calculated in the areas of interlibrary loan, reference services, claiming and binding operations and acquisitions. We estimate that the batch system resulted in a net savings to the library of \$2,408 per year, the difference between the \$15,950 of benefits and the \$13,542 of costs.

## THE PRESENT ON-LINE SYSTEM

As indicated, the Health Sciences Computer Facility which serves the Center for the Health Sciences at UCLA has an innovative program for developing terminal-oriented facilities and services for its user community. When we became reasonably sure that the facility would be able to provide a general time-sharing system, allowing users to maintain relatively large data bases and allowing several hours per day of access to such a data base at a reasonable cost, we resolved to develop an experimental terminal-oriented system for complete serials control. Our immediate objective was to design an on-line serials control system which would allow us to eliminate all card handling and keep the data base current at all times in all respects. We thereby hoped to be able to reduce the heavy workload of coding and keypunching and to maintain the file on a daily basis. If these objectives could be accomplished we would then be in a position to address ourselves to the important long-range objective of determining the conditions necessary for a system of automated library operations generally.

All the originally planned facets of the system are now operational and the experiment is no longer an experiment. I will complete the brief analysis of the computer operation costs begun above for the on-line system, and devote the remainder of the paper to the system's operation. Compared with the former batch processing system, the computer charges for the on-line system have gone up from \$7,542 per year to \$14,280. The difference of \$6,738 is almost completely attributable to two factors: rental and usage charges of the cathode ray tube terminals and rental of on-line disk space. The largest category of computer charges is now for disk space, followed in order by the cost of the terminals, listing and paper charges, and finally the central processing unit charges.

The increase in computer costs is small, however, when compared with the very significant savings totaling \$17,425 which we have been able to achieve as a result of converting from the batch to the on-line system. Virtually all coding and keypunching have been eliminated; all data is entered and verified at the source on the terminal. Two full positions have been eliminated and the programmer analyst position reduced from half to quarter time, the latter partly because of decreased supervisory duties, and partly due to the fact that the on-line system runs more smoothly than the former batch system. Time previously used for bindery preparation, updating catalog

records and maintaining various public service files is now eliminated, representing additional important savings which have been used either to accommodate increase in workloads or for reallocation to other tasks. Increased staff productivity rests on two factors: improvements in tools (terminals and listings) for processing and handling information and improvement in morale, especially of nonprofessional staff members who now have greater responsibility and an expanded view of their contributions to the library's overall operation.

To summarize the cost aspects of going on-line, the savings in personnel are \$12,679 and the related savings in binding, cataloging and reference are \$4,746 for a total savings of \$17,425. Net savings is found by deducting the increased computer costs of \$6,738, resulting in \$10,687 per year. Combining this with the \$2,408 net savings reported above for the batch system, the total is \$13,095 of yearly savings over a completely manual operation. These are the measurable direct and indirect savings within the library, but perhaps in some ways more significant are the intangible benefits of better staff morale, greater user satisfaction, and the sharing of products with other institutions. More detail is contained in: "On-Line Serials Control System in a Large Biomedical Library, Part III: Comparison of On-Line and Batch Operations and Cost Analysis."<sup>1</sup>

### Lists and Other Products

The output products of the on-line system are, with minor differences, the same as those of the batch system; the major improvement is in the quality of the output. Because of the decrease in maintenance problems resulting from entry of data at the source, plus visual verification provided by the terminal, the accuracy of the entire operation has been greatly improved.

The principal product is the daily serials holdings list (fig. 1). It contains the usual data elements of title, call number, frequency of publication, location in the library, complete holdings statement of both bound and unbound issues, and history statement; in addition, certain less usual and very useful elements are included—dates on which missing issues were claimed, date on which the latest issue was received, and bindery notes for all volumes sent to the bindery.

Computer production of claim letters are, of course, a part of this system (fig. 2). Claims are initiated by the computer when an issue is skipped, and by a program which is run periodically to find lagging receipts. The claims assistant checks the selection on the terminal screen before allowing the letter to go out, but the largest part of the work is done automatically; the claims assistant processes more than eighty letters per week in about six hours.

A large amount of time, mostly in typing, has been saved in the bindery section. Briefly, the computer produces a bindery pickup list to aid in the

**AUSTRALIAN NATURAL HISTORY.****W1 AU842****B14-16 (1962-68/0)****U17N1-2 (1971)****CONTINUES AUSTRALIAN MUSEUM MAGAZINE.****LOAN DESK****QUARTERLY****LAST REC'D-10/20/71****AUSTRALIAN NURSES' JOURNAL.****W1 AU847****B54-65 (1956-67)****U66N1-12 (1968) .****U68N2-8;AUG. (1970)****AT BINDERY--66N7-12, ON SEP 18.****CLAIMED--68N1, IN SEP.****LOAN DESK****MONTHLY****LAST REC'D-10/30/70**

Note: The location of the unbound issues, frequency and date of last receipt are on the right. Note also the "at the bindery" and "claimed" note on the second journal above.

Fig. 1. Serials Holdings List

selection of volumes to be picked up from the shelves for binding, later produces bindery slips (fig. 3) containing the bindery information for the volume, and then runs off the packing list just before the volumes are sent to the bindery.

Other products of the system include specially formatted lists of the file for use by the interlibrary loan department, serials, bindery and catalog departments, as well as a daily receipts list for record-keeping purposes and reorder letters (figs. 4, 5, 6). Upon demand, lists may be produced which utilize certain data elements. In this way a list can be made of journals by subject, language, country or other selection criteria.

To test potential use of the terminal by reference staff and patrons, a terminal was installed in the reference area for six months and a set of directions assembled to go with it as well as a scheme for reporting usage. The most significant resulting observations are the following: (1) There was a wide range of adaptability in users to the terminal. Many people found it intriguing or "fun," others were quite perplexed and found it difficult to use. (2) The consensus of the reference staff was that until additional data bases become available to be tied to our serials data base, the usefulness of this type of tool is limited. Specifically, the user wants displays of journal articles, together with authors' names and perhaps abstracts. (3) Several users frequently need access to the serials record at the same time; implementing this would mean additional terminals and additional costs. (4) Finally, since terminals are still

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BIOMEDICAL LIBRARY  
CENTER FOR THE HEALTH SCIENCES  
UNIVERSITY OF CALIFORNIA  
LOS ANGELES, CALIFORNIA 90024

FEBRUARY 22, 1971

GENTLEMEN

ACCORDING TO OUR RECORDS WE HAVE NOT YET RECEIVED THE FOLLOWING  
WHICH COMES TO US ON OUR REGULAR SUBSCRIPTION

CANADIAN JOURNAL OF MICROBIOLOGY.  
VOL 16 ISSUE 7 (1970)

PLEASE CHECK REPORT (IF REPORTING ON MORE THAN ONE ISSUE, WRITE  
NUMBER OR DATE BESIDE REPORT OR CLARIFY UNDER REMARKS.

WILL SEND IMMEDIATELY:  
WILL SEND WHEN PUBLISHED (ABOUT:                WEEKS, MONTHS)  
OUT OF PRINT:  
TEMPORARILY SUSPENDED, VOLUME, NUMBER, DATE OF LAST ISSUE:  
PUBLICATION TO BE RESUMED ON:  
CEASED PUBLICATION: VOLUME, NUMBER, DATE OF FINAL ISSUE:

REMARKS:

WE WOULD GREATLY APPRECIATE YOUR SENDING THIS MATERIAL IN ORDER  
THAT WE MAY COMPLETE OUR FILE.

OUR MAILING ADDRESS IS

BIOMEDICAL LIBRARY (SERIALS CLAIMS)  
UNIVERSITY OF CALIFORNIA  
CENTER FOR HEALTH SCIENCES  
LOS ANGELES, CALIFORNIA 90024

PLEASE NOTIFY US WHAT ACTION YOU ARE TAKING AND PLEASE RETURN  
THIS LETTER WITH YOUR REPLY. OUR REFERENCE IS 1868800.

SINCERELY YOURS,

CLAIMING ASSISTANT  
BIOMEDICAL LIBRARY

Fig. 2. Claim Letter

	YEAR	VOL.	ISSUE	SER NUM	PTS/VOL	FREQUENCY	LOCATION
ENTOMOLOGISCHE ZEITSCHRIFT. W1 EN971	71	81	1-24	2728500	01	SEMI-MO	INCOMPLETES
ENVIRONMENTAL HEALTH (LONDON) W1 EN996E	71	79	1-12	2733900	01	MONTHLY	INCOMPLETES
EUROPEAN JOURNAL OF BIOCHEMISTRY W1 EU726	71/2	24	1-3	2782500	01	IRREGULAR	READING ROOM

A. PICKUP LIST (Packing list looks the same except last four columns are omitted.)

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.....
03/21/72  VOLS THIS TITLE: 1

ARCHIVES OF PHYSICAL          BIOMED.
MEDICINE AND REHABILITATION   W1
                                AR469
                                V. 52
                                NO. 7-12
                                1971

B. BINDERY SLIP.

                                52
                                JUL.-DEC.
                                1971

1222500
CLOTH COLOR - BLACK
COVERS - BIND FRONT
ADS - LAST COPY ONLY
INDEX - BIND IN BACK
.....

```

Fig. 3. Bindery Products

relatively expensive, it is difficult to justify them on a cost basis unless constant and highly productive use is made of them. The daily lists have proved to be a much more acceptable method of getting the information to the user than the terminal. The data on the current day's list is virtually as current as that which could be obtained from the terminal; in addition, two-, three-, and four-day old lists left in the reference area provide a multiple access which is impossible with one terminal. To conclude, unless the cost for terminals decreases or larger and more varied files become available containing so much data as to be impractical to list often, a terminal for public use of this type is not practical. The great usefulness is for the input process and for various technical processing procedures for which the serials staff are responsible.

Parenthetically, the reliability of the computer system is a very important factor in determining the usefulness of any terminal system. The test mentioned above was done during the latter half of 1970 when the computer facility was having certain difficulties with both its software and hardware. Although this was an annoyance at the time, we believe the basic conclusions mentioned above would have been the same even with a more acceptable computer system. Since that time the reliability of the system has greatly improved.

0003600 ACCMA BULLETIN. (ALAMEDA-CONTRA  
COSTA MEDICAL ASSOCIATION). W1 AL182  
(GIFT)

000600 ADM. REVISTA DE LA ASOCIACION DENTAL-  
MEXICANA. W1 A389 (GIFT) ORG123

A. List used in bindery dept.

0006900 1 MTC-12 FREQ- 1 RT/LOC-B S  
A.E.T.F.A.T.-INDEX. Z 5356 S7 ALL3  
B(1953-56).B(1959-67)U(1968)U(1969)  
U(1970)

0023400 1 MTC-12 FREQ- 1 RT/LOC-B RFR  
AMA DRUG EVALUATIONS. QV 740 A254  
B(1971)

B. List used in serials dept.  
(list used in interlibrary  
loans and cataloging have  
a similar format).

Fig. 4. Internal Lists

BIOMEDICAL LIBRARY  
CENTER FOR THE HEALTH SCIENCES  
UNIVERSITY OF CALIFORNIA  
LOS ANGELES, CALIFORNIA 90024

FEBRUARY 12, 1972

CALIFORNIA DEPT. OF FISH AND GAME  
1416 NINTH ST., 12TH FLOOR  
SACRAMENTO, CALIF. 95814

GENTLEMEN:

PLEASE CONSIDER THIS A FORMAL PURCHASE ORDER FOR THE FOLLOWING:

ANNOTATED BIBLIOGRAPHY OF RESEARCH IN ECONOMICALLY IMPORTANT  
SPECIES OF CALIFORNIA FISH AND GAME. SUPPLEMENT.

ISSUE 7

PLEASE INVOICE US IN TRIPPLICATE.

IF THIS PUBLICATION IS NO LONGER AVAILABLE, OR WILL BE  
AVAILABLE AT SOME FUTURE DATE, PLEASE LET US KNOW AS SOON  
AS POSSIBLE.

OUR REFERENCE IS 1075800-9

PLEASE RETURN THIS LETTER WITH YOUR REPLY.

THANK YOU FOR YOUR ASSISTANCE IN BRINGING OUR RECORDS UP TO DATE.

SINCERELY YOURS,

Fig. 5. Reorder Letter

TITLE	CALL NUM.	YEAR	VOL.	ISSUE	FREQUENCY	LOCATION
AMERICAN JOURNAL OF MEDICINE.	W1 AM4926 COP.2	1972	52	1	MONTHLY	READING ROOM
AMERICAN JOURNAL OF OPHTHALMOLOGY.	W1 AM4959	1972	73	1	MONTHLY	READING ROOM
AMERICAN JOURNAL OF OPHTHALMOLOGY.	W1 AM4959 COP.2	1972	73	1	MONTHLY	READING ROOM
AMERICAN MEDICAL ASSOCIATION JOURNAL.	W1 AM554	1972	219	4	WEEKLY	READING ROOM
AMERICAN PSYCHOLOGIST.	W1 AM6744	1972	27	1	MONTHLY	READING ROOM
ANTIOQUIA MEDICA.	W1 AN875	1971	21	6	10 PER YR	LOAN DESK

Fig. 6. Daily Receipts List

## Hardware and Software

The system was originally designed to work from IBM 2260 cathode ray tube (CRT) terminals with a display area of eighty characters across by twelve lines down. Selection of terminal was made on the basis that the IBM 2260 was available and supported by the computer facility. Plans are currently underway to allow general use of the system with other types of CRT terminals, although there are two major constraints: (1) unless a great deal of reprogramming was done, the screen size would have to be eighty characters across to accommodate the displays which the programs sets up; and (2) the data transfer rate would have to be fairly rapid since most displays entail several hundred characters.

The programs are all written in PL/I and both the programs and the data file have been designed for use on a large time-sharing computer system such as exists at the Health Sciences Computer Facility. The on-line programs presently run in a 100K region which is dynamically rolled in and out of memory onto drum storage space by the operating system. All programs which run the terminal are linked together into one large program so that they are immediately available for use at all times. Taken together, the amount of memory required for these programs greatly exceeds 100K, but by using overlay programming techniques only a small amount of programming code is in memory at any one time. Considering the overhead required for the terminal system, however, it would appear that 100K, or perhaps 80K at the least, defines the practical size of memory required to run such a system.

The machine files are set up in one physical file of about 930 tracks on an IBM 2314 disk pack. This is about 7 million characters of storage and is less than one-fourth the capacity of one disk pack of this type. All journal records are in alphabetical order and arranged by the unique access-serial number assigned to them when cataloged. Thus the tracks which contain the master file of data may be thought of in much the same way as a block of records in a sequentially organized tape file. However, with a block of records

on tape no updating of that tape can be made without copying it onto another tape; with the disk file the potential exists for in-place updating. This capability, of course, lies at the heart of the on-line file maintenance system.

Not all tracks on the disk file contain the master serials file data, however. Certain tracks have been formatted for storage of the retrieval data, others for bindery, claiming and daily receipts data, and so on. There are nine special purpose logical files in all which are maintained in a dynamic fashion by the programs, all contained on the 930 tracks allocated to the serials' control system.

The master file of serials consists of the 6,500 current journal records, one for each title, together with about 5,500 ceased, on-order and cross-reference records. The record format is somewhat similar to MARC II in concept, containing an average of about eight tagged variable length fields and normally two fixed length fields. The records average about 400 characters in length. When the records are blocked together on the disk tracks, a slack of about 600 characters is left at the end of each track. Thus, during daily operations at the terminal causing the length of various records to change, extra space is available as needed from this slack area. Once or twice per month the whole file is regenerated on disk to evenly redistribute the slack area. A more detailed account of the file maintenance concepts is contained in "On-Line Serials Control System in a Large Biomedical Library, Part I: Description of the System."<sup>2</sup>

### Retrieval Features

The system utilizes an inverted file for its primary retrieval technique. About sixty tracks of the disk have been reserved for storage of the inverted file data, which index all title words of significance, and all subjects, languages, and countries to the appropriate records in the master file. This is about 7 percent of the total of the 930 tracks which are allocated to the serials system.

The file is set up as follows. A program reads each master file record and breaks out all words in the title. The program discards some twenty commonly occurring articles and other insignificant words, and also truncates all words containing over fourteen characters. At the same time, the program processes all the subject, language and country codes. To each of these resulting retrieval elements it adds the journal's serial number. The program then sorts the entries found for all the titles by term and by serial number. The last step consists of removing all duplicated terms but one, while saving the serial numbers which provide the link back to the master record in a string and storing the result on the disk space reserved for this purpose. This whole procedure is repeated perhaps once monthly since dynamic updating of this file is not provided for in the present system.



The operator who uses the terminal to retrieve a journal may key in one or more words of the title of the desired journal. Over 50 percent of all resulting terms in the inverted file have only one title linked to them, so an operator with some experience can very often key only one word to retrieve a unique title. Tests have determined that the correct title is reached about 80 percent of the time if an average of three title words are entered. When a unique title is not reached, the operator normally has a list of from two to six titles displayed which have satisfied the keyed search criterion; normally the correct title is among the list and it is a simple matter to pick it out.

When more than one term is required to find the desired title, the terms may be entered one at a time, waiting for a response each time, or more likely, the terminal operator will key in several terms at once so the program need not keep displaying intermediate results. In either case Boolean anding is performed automatically as long as title words are entered. If the operator should wish to search by subject, language or country, a similar sequence takes place except that the program does not automatically assume Boolean anding, but rather gives the operator the choice of AND, OR, or AND NOT.

In addition to retrieval by use of the inverted file, the operator may, of course, use the seven-digit accessions number if it is available. This method is slightly faster because it guarantees a single response every time. Most of the bindery and claiming operations entail using a computer-generated list which has the serial number printed on it, so this method of retrieval is often used in these instances.

The following points should summarize some of the more important aspects of the retrieval scheme: (1) the method of setting up and using the inverted file described above has proven to satisfy the retrieval requirement from a design point of view. It is not particularly expensive nor difficult to maintain. It is easy to use and is sufficiently accurate to be readily understood and accepted by operators of the terminals. (2) Certain features of the concept have useful side effects. For example, transliteration of a title can be accomplished by simply transliterating the easiest word, keying it in and letting the computer display the journal or journals found. The operator should recognize the correct title and can proceed to copy the rest of the transliteration of the title. (3) Since the words may be truncated when keyed in by the terminal operator, it is often a simple matter to key in merely a few letters of a word to retrieve the correct title. (4) Also, related to the transliteration problem, a particularly obscure journal may be retrieved by merely keying in its language or country rather than the title. Finally, any misspelling in a title is soon discovered when this method is used for retrieval. Further discussion of the retrieval aspects of the system is given in "On-Line Serials Control System in a Large Biomedical Library, Part II: Retrieval Features."<sup>3</sup>

## Terminal Operations

As indicated above, the on-line system has a complete complement of check-in, bindery, and claiming modules. In addition, there are programs to change all fields of a record and to add or delete whole records. There is also a set of system control routines which are used by the systems staff to display and monitor the files in the system. Several special purpose file updating capabilities are provided for the programmer's use in this set of routines.

At the present time there are two terminals; their combined usage of approximately seven hours per day is broken down as follows: (1) four hours checking in an average of about 150 journals, (2) one hour each for bindery, claiming, new entry and other miscellaneous use. Additional time should be allowed for development work by the systems staff and for giving demonstrations. Scheduling the workload would probably become a problem if only one terminal were available since computer downtime, both scheduled and unscheduled, averages perhaps an hour a day, and since the various terminal operations are often done by different members of the staff on different floors of the library. We have not, of course, hired special operators for the terminal. Members of the staff use the terminal as a tool just as they use the telephone or typewriter. The operation of the terminal is relatively straightforward and only a short time is needed for operator training. For new personnel, use of the terminal is a minor aspect of their normal job training. Library interns, for instance, become reasonably competent at the check-in aspects after one day of working with the check-in person. The great advantage of a CRT-type terminal is that normally all response codes to a given frame can be displayed: the beginning operator merely takes cues from the displayed message to proceed to the next message, and so on.

The serials control system described above has been fully operational for many months. Although it is fairly large and complex, it has proved to be quite manageable, and, most important, meets our library needs in the area of serials control. Most heartening is the fact that the system has shown definite cost advantages. The computer facility is admittedly subsidized to a certain extent by the federal government on the basis that it is a research facility, but even with somewhat higher computer costs, we believe the system could justify itself.

Finally, although no further developmental work is now being done on the system, we do have plans for future improvements including the addition of an invoicing module, redesign of the file format to save disk space, and generalization of the system to be able to use a terminal other than the IBM 2260. These and other improvements will be predicated on two considerations: (1) improving the cost-benefit ratio of the system within the library, and (2) making the system more easily adaptable for other libraries.

## REFERENCES

1. Fayollat, James. "On-Line Serials Control in a Large Biomedical Library, Part III: Comparison of On-line and Batch Operations and Cost Analysis."
2. \_\_\_\_\_. "On-Line Serials Control in a Large Biomedical Library, Part I: Description of the System."
3. \_\_\_\_\_. "On-Line Serials Control in a Large Biomedical Library, Part II: Retrieval Features."

These papers were all recently submitted to the *Journal* of the Society for Information Science for consideration for publication.

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## On-Line Real-Time Self-Service Circulation at Northwestern University

Before discussing circulation, some background on the situation at Northwestern University might be in order. In the first half of 1967, a detailed study of all the library's operations was made because it was obvious that some changes were necessary. Over the years, many procedures had degenerated and were now being done primarily because they had been done that way before. The results of the study indicated that a new approach was needed; a completely integrated system should be developed and maintained. It was further apparent that only a system that was efficient and responsive would have substantial impact on the library's operations. Only one direction appeared to provide a possible solution—an on-line, real-time system.

Design and development of a completely integrated library operating system was to be done in modules; the first to be tackled was circulation. The major intent of the circulation module is to maintain control over those items in the circulating collection which are not in the location described in the card catalog. The circulation department as a whole is certainly interested in every item put out by technical services, but the computer-based circulation system is involved only when an item is removed from its assigned place for more than casual browsing or normal in-house use. At that point, a record is created indicating the item in question, the user (student, faculty member, department, another library, cataloger, or the bindery), the date on which this transaction took place, and the date of the end of the particular loan period. If a question should arise about a particular book, the file can be interrogated, the record displayed, and certain changes made, if necessary. Upon return of the book, the record is deleted from the file and the item returned to its

proper location. Certain other housekeeping chores are accomplished over a period of time, such as overdue notices, fine notices, or requests to return a book.

The heart of the system is an IBM 360-30 computer which is shared with the university's administrative data processing department. It has a core memory of 96K, with the library teleprocessing system utilizing a 48K foreground partition. The circulation file is maintained on IBM 2311 data cells. The computer is located in an administration building about one-half mile from the library. Two dedicated phone lines are used to connect the computer with the various terminal equipment in the library. This terminal equipment will be described in more detail below.

The teleprocessing and batch programs are written primarily in assembly language. The teleprocessing package, in addition to circulation, also handles a complete technical services operation. Implemented early in 1972 this part of the system covers all types of material at all stages of processing, from preorder searching of MARC records to production of punched book cards for the circulation module.

One of the major considerations in designing the module was deciding on the means to collect the book data. Either the data are reconstructed each time the book is presented for charging, or data are carried in machine-readable form by the book. In the former case, manual transcription can lead to many errors, and, depending on the type of data involved, it can be time-consuming and/or difficult to construct accurately. In the latter case, machine-readable data can be used over and over again, will not vary from time to time, and can be ready very quickly by a machine.

At Northwestern the use of at least the call number for book identification was anticipated. Although the classification number is generally straightforward (the Dewey Decimal classification system is used), such elements as Cutter letter and number, work letter(s), and the edition, volume or copy, can become fairly complex. Also, in a collection of more than one million volumes, many items differ in call number by only one or two out of twenty or more characters. Almost everything seemed to indicate that a punched book card was necessary. Once this decision was made, it became necessary to determine the data elements to be converted and the way in which the book cards should be prepared.

A survey of the literature led to the conclusion that there were two ways of approaching the problem: (1) convert-as-you-go, that is, make book cards as books circulate, or (2) convert-at-one-time, prior to implementation. An interesting discovery concerning the as-you-go method of converting as books circulate was that its major proponent gathered data in the very libraries in which we are working. Unfortunately, no actual cost comparisons were made. While several approaches were mentioned for the one-time method, there are very little data of value.

Another conclusion that rapidly became obvious was that little, if any, consideration was being given to the need for the presence of certain data elements in the punched card and/or the circulation file. Identification of a book by call number and/or accession number, and some or all of the author and title seemed to be taken for granted. Where this was not so, no reason was given for the particular data elements used or omitted. Answers for many of our questions were not in the literature.

The data elements to be converted were given first consideration. Since the items to be controlled are normally shelved and retrieved by call number, this would be the most direct means of identification. Also, the call number is unique; only by error would two or more items have the same one.

An accession number would also be unique, but in looking for a particular book it would become necessary to utilize both the accession number and the call number which would be both cumbersome and redundant. Also, if the circulation file were ever to be analyzed in terms of usage of parts of the collection, the accession number would be meaningless. To use only the author and/or the title would introduce some sticky problems: it is not always easy to determine the exact author and title of a book; these data fields would often be longer than either the call number or the accession number and therefore more difficult to reconstruct accurately; it would be difficult to distinguish between multiple copies, volumes or editions; and foreign materials, especially items in Russian, Chinese or the like, could not be handled in the original language. Again, analysis of the file would be most difficult.

It became evident, then, that use of the full call number was the absolute minimum. But was it sufficient? Admittedly, it would be "nice" to have at least some portion of the author/title data available in the book card and in the circulation file. This is especially true since the major use of such data would be for printed notices (overdues, fines, etc.) sent to users. Obviously there would be increased (one-time) costs in converting more than the call number. Carrying these extra data fields in the file would also increase the file size—by at least one-third—but this would be an ongoing increased cost. Would these increases buy more than something "nice"?

A look at the library's records indicated that less than 5 percent of the items that circulated required any kind of follow-up other than discharge. Those increased costs, then, would be magnified in terms of a percentage of usefulness. Also, if a more complete bibliographic conversion was ever attempted, such partial data would not be usable. Since no estimate of the increased costs due to conversion could be made at the time (the increased file costs could be estimated), no final decision was made—only a temporary one to forego author/title during a comparative study to be undertaken.

While it was estimated that convert-as-you-go was cheaper, the library staff was not anxious to live for an extended period under two systems. It

was felt that while living under two systems the best features of either, especially the new one, would be terribly overburdened by the poorest features of either, especially the old one. It was decided to run a short experiment in order to determine the best and cheapest method for one-time conversion.

Two alternative methods were chosen for study: (1) keypunching directly from the shelflist, and (2) typing sheets, directly from the shelflist, to be scanned later by optical character recognition (OCR) equipment and converted via computer to punch cards.

Because of the constraints imposed by the scheduled implementation date, very little time was available for rigorous experimentation. While work continued on design of the system, from two to four hours a day over a period of seven days were devoted to the testing. We felt that the results would at least be indicative of the real costs.

Keypunching, though requiring a somewhat longer period of time, appeared to be the cheapest method. (OCR was less expensive until the computer time for producing the cards and subsequently running them through an interpreter was included.) Use of keypunch machines could also permit a complete in-house operation and would allow day-to-day control over the final product. Moreover, the testing indicated that error rates in the OCR method might be significantly higher, since it was more difficult to read the typed sheets than the punched cards (due to the OCR input being encoded in a manner that made proofreading difficult). The question of adding author/title data was reopened at this point. Indications were that an additional \$50,000-\$60,000 would be needed if these two elements were to be included for each record. The call number would have to suffice, and an in-house keypunch operation would produce the book cards.

The major portion of the operation, conversion of the items in the main stack collection, took sixty-four days. Some 700,749 cards were produced at an average cost of 1.1 cents per card, with the costs broken down as follows:

operators	\$4,200
equipment (4 IBM 029 keypunches)	960
card stock	980
supervisor	<u>1,600</u>
	\$7,740

The keypunching operation was then reduced in scope, other smaller collections were converted, and all new items were routinely routed through keypunch prior to shelving. An effort was subsequently made to put the cards into their respective books. By the time the circulation module was put into operation, over 800,000 books were ready to go. For about \$30,000, or just under \$0.04 per book, machine-readable cards were prepared and placed in the books, and a general inventory had taken place.

Part of the decision to use punched book cards was, of course, related to the availability of equipment to read the cards. IBM 1031 badge/card readers, while far from ideal, were found to be at least usable. As used at Northwestern, these units are one-way machines; they simply transfer data from the library to the computer. Associated with each badge/card reader is an IBM 1033 printer. Essentially a Selectric keyboard, this too is a one-way machine, strictly under computer control and only capable of printing out a small variety of messages. The current configuration in the main university library consists of four of these 1031/1033 units. Units are located on the third, fourth and fifth floors of the university library. They are used exclusively for the processing of standard book loans. A standard loan implies a book with a punched card, a user with a punched identification badge, and a normal loan period, currently four weeks. If any one of these three criteria is missing, the user must go to the main circulation desk. The 1031/1033 unit located there is slightly different—the badge/card reader also contains a set of twelve slides. These slides allow a variety of transactions to be processed. The only necessity is a punched card with the book information. The slides can then be set to provide for any one of several loan periods and also for user identification if no badge is available.

The major functions of the unit at the main circulation desk are to handle renewals and discharges. The discharges amount to about 1,000 items per average day, with peak periods during the year being several times this figure.

For each transaction processed through the unit (in all but two special cases), a message is printed out on the associated 1033 terminal. There are six basic messages currently in use. The most common is the date due. If an attempt is made at a first time charge, and if the data input through the terminal are acceptable (a valid call number which is not already in the file, and a valid user number, by badge or through the slides), a message will be quickly printed, showing the user number, the date due and the call number of the item. This message is then removed from the terminal, placed in the book, and is the user's pass to borrow the item from the library.

If, however, any of a variety of factors are not as they should be, another message will be printed. In place of the due date will appear UNPROCESSED ERRXX. If this occurs at one of the units in the stack area, the user should take his material and the printed slip to the main circulation desk. The staff at the main desk can then, hopefully, discern the reason for the error message and make the proper adjustments. The types of errors that can occur, and that can be "caught" by the program will be discussed below.

The third type of message is actually very similar to the first type, the date due. It occurs when an item is renewed. In lieu of the words DATE DUE, RENEW TO is printed, and the new date is calculated by adding the same length of loan period as in the prior transaction to the current date due. Thus, an item may be renewed any time after the initial transaction up to and



including the third day after the date due. Beyond that date, special handling is required. Also, an item may be renewed only three times; the fourth attempt will be rejected. If so desired, either situation, overdue by more than three days or over-renewed, can be circumvented by simply discharging the item, then starting the cycle anew with an initial transaction.

The fourth type of message is also similar to the first type. It indicates that the charge is to a carrel and for an indefinite period (in reality, for a quarter). Faculty and students who have assigned carrels have this privilege. The item, however, may not be taken from the library. The word CARREL printed in place of the due date indicates this to the user and to the exit attendant.

The fifth and sixth types of messages occur when a book is discharged, a simple operation which entails running the book card through the badge/card reader after setting the appropriate slides. In the usual situation, no message is printed when an item is discharged, even if a fine is to be assessed. Fine notices are generated by the evening batch runs. However, if another user has requested that a save, or hold, be placed on an item so that he may have it next, at the time of discharge a message is printed with the identification number of the requester, the call number of the item, and the words SAVE REQ. The item is then put on a special shelf, and the batch program that night prints a notice for mailing that the item is available.

The fifth type of message occurs when an item that has been determined to be lost or missing is attempted to be discharged. Lost or missing items are routinely put into the master file so that, for example, if a lost item suddenly popped up, the borrower who had reported it lost and probably incurred a fine may be at least partially reimbursed. The message in this case reads LOST/MSG.

The second type, the error message, covers a wide variety of situations including:

1. record already in file—such as books returned to the stacks before being discharged or attempted renewals on the units located in the stack areas,
2. invalid record length—including book cards without sufficient data or dropped digits on user numbers entered on the slides,
3. invalid charge code—e.g., attempt to give indefinite loan to regular borrower,
4. invalid user number—for expired badges,
5. cannot renew—overdue,
6. cannot renew—already three renewals,
7. cannot renew—save on file,
8. record not in file—for attempted renewal of item not yet charged out or discharge of item not charged out,
9. record being processed by another terminal,

10. user number in hold list—a small list of numbers can be put into a special hold list, such as users with large unpaid fines or lost badges,
11. expired badges,
12. attempted transfer of noncarrel charge—carrel charges, to a room or desk number, can be transferred to a user for outside borrowing, and
13. invalid transaction date in slides—it is possible, for example, to have books discharged as of an earlier date (because of backlogs or machine down-time) and dates outside a given range rejected.

The conditions which generate the foregoing messages are usually easily taken care of by the circulation department staff. Certain other situations—system errors—entail a stop of operations and consultation with the computer operator or the programmer.

The instances where no messages are printed are when a valid discharge takes place and when items charged out do not require date due slips, such as books being put into the reserve room. Suppression of such unnecessary messages saves a great deal of machine and operator time.

While most error conditions are caught by the system program, there are, of course, some errors that cannot be caught. If a book card or a user badge has transpositional errors, that is the way the data go into the record. Once the record is created, the only way to “see” the data therein is through the IBM 2740 typewriter terminal. There are no hard copy listings of the circulation file. Access to the file can be made only by call number. It was decided that in an academic environment it was most important to know the status of a particular item, what was had by whom, rather than who had what.

For purposes of searching the file, the call number was broken down into two components, the key and the key extension. The key is made up of the Dewey number, Cutter letter and Cutter number, and work letters (these identify different works by the same author on the same subject). The key is used to compute the address on the data cell where the record is stored. The key extension carries such data as edition, volume, copy, location and oversize indicator. The file can be searched using just the key. This allows for quick access to, for instance, all records in the file for multiple copies of the same title. It also can provide for the display of fifteen records when fifteen volumes of a set are charged out which is a bit inconvenient at times. But this is far overshadowed by the problems that can occur in attempting to properly interpret some of the strange alphanumericics that can be assigned beyond the basic subject, author, title code: copies of volumes of parts of sections of editions, etc. It is far easier to see whether what is in the file fits the question, rather than vice versa.

It is, of course, possible to go directly to a record by using both the key and the key extension. Either approach has its benefits and drawbacks.

There are two levels of searching the file. The first uses the search command with the key, and the response, assuming one or more such records reside in the file, gives the address of the record(s) and the key extension(s). Then the desired record can be displayed by indicating the desired record address. This is done primarily because the 2740, being a typewriter terminal, is a very slow device—one line of record location is much quicker to print than three or more lines of record data. The other level is to use the display command and both the key and key extension. In either instance, the terminal operator has a choice of displaying the entire record, or any part of it. This particular approach may not be absolutely necessary to the circulation file where most records contain only three data fields. However, the same command language is used in the technical services module, and records in that file are larger.

It is possible, once the record is displayed, to alter the record by changing or adding another field. In fact, the entire record can be deleted from the file. Since operations through the 2740 do not go through all the error screening routines of the circulation program, care must be taken to avoid entering significant errors into the record. To help guard against such possibilities, there are three distinct levels of operator capability, controlled by operator codes. The lowest level allows only for display of records. The middle level additionally allows for changes of certain fields and addition of others. The top level allows for all activities, including deletion of records. The deletion of a record through the 2740 completely removes it. Discharge through the 1031, meanwhile, if overdue or carrying a save, removes the record from the master file to a daily transaction file, against which the batch programs are run each evening.

Each evening, except Friday and Saturday, the daily batch programs are run. These programs, which generate notices regarding fines, recalls, and book availables, are run against the transaction file. This file is generated during the period between batch runs. When an item is discharged, the record is removed to the transaction file, and whenever a record is altered at the 2740 terminal in such manner as to necessitate a notice that record is also copied onto the transaction file. The notices are delivered to the library the following morning, where they are stuffed into envelopes and mailed.

There is no continual machine follow-up on fine notices. The original notice is a four-part form; after the initial mailing, the three remaining parts are used for manual follow-up, if necessary. The notice that a book that had been requested is not available is a one-time thing. If the book is not picked up within a reasonable time, it is returned to the stacks. The recall or book-needed notice, is followed up, but as part of the weekly overdue run.

Once each week the overdue program is run against the master circulation file. Items usually have a four-week loan period, though there is a built-in capability of making loans for two, four, six or eight weeks, and indefinitely.

Notices are thus prepared for items based on the due date, provided they fall within a certain number of days of overdueness; for example, first overdues are more than four but less than twelve days and final overdues are more than thirty-two but less than forty days overdue. On a two-week cycle, then, following the initial notice, overdues are automatically followed up.

In the case of faculty (who are not subject to fines), items are charged to them for the regular loan periods, but no overdue notices are prepared, except for recalls. At the end of each quarter, a listing is sent to each faculty member indicating the items still charged to him.

Also on a quarterly basis, listings are generated for items on indefinite loan. This includes charges to departments, such as cataloging or reserve room, and to carrels. Also included are those items charged to lost or missing. Thus all items in the file are completely followed up on at least a quarterly basis.

Management reports, so far, are at a minimum. This has primarily been due to the priority placed on bringing the technical services module to completion. Output is presently prepared on a weekly basis showing, by particular Dewey classification, the number of items charged out under a variety of categories: students, faculty, guest borrowers, reserve room, lost/missing, other libraries, departments, and renewals.

One use to which these data have been put is a follow-up on a policy change made early in 1971. During the first year of the systems operation, the loan period was two weeks. The circulation department felt that the number of renewals was using up an inordinate amount of staff time. They suggested that a four-week period would provide a better operating environment and might also serve the user better. It was further anticipated that while the number of save requests would probably increase, these would be offset by a decline in renewals.

The data studied covered two six-month periods—one with the two-week loan, the other with the four-week loan. It was found that the number of saves increased by 109 percent while the renewals decreased by 38 percent. Translated into time units, however, 12 percent less time was spent in processing these requests. This certainly confirmed the department's feelings, especially since there was an increase in overall circulation of just over 31 percent.

Every member of the circulation department is extremely happy with the system. As head of the department has stated, "No one on the staff would consider returning to the manual system." When everything is functioning properly, things could hardly be better. But, being a completely on-line system, it is at the mercy of the equipment. If a 1031/1033 terminal goes down, there is at least some inconvenience. If the 2740 goes down, there are problems. If the phone lines act up, there are big problems. If the computer "gets sick," there goes the ball game—almost. Fortunately, the amount of downtime of these items is generally inversely proportional to the problems

created. Thus, while some of the equipment may occasionally be out of service, the average amount of downtime for the system as a whole, can be measured in, at most, a few hours per week. Certainly a livable situation, but of sufficient concern to warrant certain back-up capabilities.

In addition to coping with machine downtime, there must be quick and fairly efficient means for charging out items which have no prepunched book cards. Putting these two conditions together, the back-up system consists of a Standard Register Source Record Punch and a two-part form. This form, with carbon interleaf, provides a date due slip (top part) and a composite card for later processing when the system comes back up. When necessary, the borrower presents the book card and ID badge at the main circulation desk. These are placed in the source record punch and the data are transferred to the two-part form. Also transferred are data from internal slides, thus preparing a printed date due slip and a punched composite card—so called because this one card carries all the data needed for the master file record. When the system resumes operation these cards are given priority handling.

This is a comparatively slow process and the machine is far more sensitive than the 1031. It all too frequently misses punches, especially in poorer quality badges. This is rarely discovered until after the user has departed. But on the whole, it does a much better job than keypunching all the data into the card which is necessary when there is no punched book card.

In this case, the call number is printed on the form, along with the user number, and the due date is stamped in the appropriate location. The top slip again goes with the book, and the bottom card goes to keypunch where it is turned into a composite card. At the same time a book card is prepared, to be filed awaiting the return of the book. Copying of call numbers and ten digit user numbers is extremely error prone and keypunch errors do occur. Again, these cards must have priority handling to insure their entry into the system as soon as possible. When delays in keypunching occur, it would be possible to have the book returned and "discharged" before the composite card is ready for charging.

The major problem with this back-up is that transactions take place without the usual error detection in operation. An item being renewed may have a save requested, it may already be in the file for some strange reason, or the user may be one of those whose number has been blocked.

What has been the impact of the computer-based circulation module on the library? Most noticeable to both the staff and the users has been the change in actual operations involved with charging out an item. For about two-thirds of such transactions, it is a self-service operation. The three 1031/1033 terminals located in the stack areas are not manned. The user, who has a badge and desires to borrow a book which has a punched card, approaches one of these terminals, places his badge in the appropriate slot of the 1031, and places the book card in its slot. In a few seconds the terminal reads and ejects the

badge and the book card. Then the 1033 printer goes to work and prints the date due slip. The user pushes a specially designed lever on the top of the printer which cuts the paper; and then he removes the slip. The slip and book card go into the pocket of the book and the badge goes into the user's pocket. He shows both the book and badge to the exit attendant and leaves the building.

Security is a very important factor in today's library. At Northwestern there are attendants at each exit to check on material leaving the library. The computer-produced date due slips offer a means for positive identification of all legitimately borrowed items. The call number on the slip can be compared with the call number on the book pocket and the identification number of the borrower can be compared to the ID card. This has, of course, not stopped all losses, but it has been significantly helpful.

In almost all instances, the user has spent a shorter period of time doing the charging himself than if he had had to use the services of a circulation assistant. The circulation department staff member, meanwhile, has gone about other business.

Much of the work of the circulation department personnel has changed. No longer are most of them tied to the task of continually filing and then unfiled charge cards. No longer do they have to spend innumerable hours deciphering names and addresses and then typing overdue notices. No longer do returned books pile up into small mountains because of lack of help or because there is limited space around the filing bins to get at the book cards. No longer can faculty borrow books "forever" because there is not enough time to send out regular (or even irregular) reminders to them.

No longer do staff members feel that the collection controls them. Now, they control the collection. Filing and unfiled the circulation file is handled by the computer. While renewals must still be handled by a staff member, more and more charging by special borrowers is being done on a self-service basis as punched badges are provided for guest borrowers and carrel holders. The processing of overdue notices has almost been reduced to an envelope-stuffing operation. The slips are inspected prior to stuffing, primarily to catch long overdue items for special handling. Names and addresses for university borrowers are printed on the notices; the batch programs have access to the student and payroll files to gather such information. On most days, only about four to five man-hours are needed to discharge returned books. Requests to check if a book has been charged out are easily processed through the 2740. Usually, there is an assigned operator on duty, both because there is a constant stream of such requests and because there are a number of file maintenance chores to perform—mail renewals, saves, and problems of various sorts. Fine notices, though only partially automated, are much easier to handle. All long-term borrowers are reminded of items charged to them on at least a quarterly basis. The staff knows that the situation is well in hand and that those areas of continued concern will be improved.

Because the system has freed so much time from simple but necessary clerical operations, the department has been able to do things which, while probably in its domain in the past, could not be effectively handled due to this heavy clerical load. Some new responsibilities have even been added: a complete inventory matching the card catalog and the holdings is under way, the collection and the card catalog are being brought into agreement, and incomplete holdings are being brought to attention.

Now that the collection is under better control, both internally and externally, the user is better served. Items are easier to find because they are more often where they should be, or are kept track of in the master file. This file also contains records of transactions in the Technological Institute Library, the largest branch on campus. (A 1031/1033 unit and a 2740 are used there, although because of smaller volume, there is no self-service operation.) Other libraries on campus may eventually be brought into the system, making the main library's union catalog an even more effective tool. There is much built-in flexibility, so that not only can a variety of due dates be offered, but items can be coded in a variety of ways—Dewey, arbitrary number, LC classification, etc. It should be mentioned that the decision to omit author and title data on the book cards has met with almost no user complaints. In the more than two years of operation, only a few individuals have made any negative comments.

But the system is not quite perfect. Some of the equipment, especially the 1033 printers, cause problems. Paper jams regularly occur, although far less frequently since the installation of specially designed cutting blades and paper channels. Badge quality is very important, and has at times caused innumerable problems. Improvements can be made, such as an on-line file of valid users and a blocking pattern that could do away with the traditional monetary fines. Automatically suspending borrowing privileges until overdue items are returned might be much more reasonable and effective.

But these are minor considerations in light of the successes so far achieved. In operation since January of 1970, the system has proven its effectiveness. While there has not been any reduction in staff, added tasks have been easily absorbed, as have significant increases in circulation volume.

Northwestern University went to an on-line system in order to produce a substantial impact on library operations. There is no question but that there is such an impact.

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## Shawnee Mission's On-Line Cataloging System: The First Two Years

The last detailed article about the Shawnee Mission (Kansas) Public Schools' library system was written during the summer of 1970 and published in March 1971.<sup>1</sup> This paper reports major events from April 1970 through March 1972. It quantitatively describes the on-line system, discusses management issues, and reports on plans for future development.

Given the general dearth of continuous quantitative and qualitative reporting about library computer applications, it is hoped that this second article will be followed by later performance analyses. Periodic reporting is particularly critical in library areas with relatively little automation, such as school and medium-sized libraries.

To put this paper in its correct perspective, it is necessary to know that no major changes have been made during the past two years in either the hardware or software support systems for library on-line cataloging. The current configuration includes: IBM 360/40; DOS 256 K; eight 2314 disks; one 2702 line control; 2741 terminals for student use via APL (A Programming Language); 2740 terminals for library on-line cataloging; and three core partitions for APL, library FASTER (Filing and Source Data Entry Techniques for Easier Retrieval), and batch operations during first shift.



## TWO MAJOR EVENTS SINCE SYSTEM START-UP

The on-line cataloging system began in April 1970 when four elementary collections were entered via terminal: two collections were entered retrospectively from shelflists, and two represented newly built schools. The four schools contributed about 10,000 titles to the new on-line system.

### Converting 45,000 Batch Records

During the summer of 1970, work began to merge the 10,000 new elementary title records with 45,000 batch records for secondary schools. The batch records had been created during the previous two years while the first automated library system operated. Three major tasks developed: (1) intelligently converting upper-case records to upper- and lower-case records; (2) finding the duplicates among the 45,000 batch records, and (3) enlarging almost all fields. To the authors' knowledge, these tasks have been attempted only at Shawnee Mission; the problems and ultimate success can perhaps aid those with similar tasks.

Several factors affected the approach taken: (1) aside from the massive bibliographic difficulties of merging the two files, new materials were stacking up; (2) two previously separate central processing groups had joined into the new on-line Library Technical Processing (LTP) group and the LTP staff was anxious to take ownership of the on-line system; and (3) the authors were involved in other projects simultaneously.

The following steps were taken to merge the elementary and secondary records:

1. All 45,000 batch records were transformed into upper- and lower-case format and compared with the elementary upper- and lower-case records. Unfortunately, no duplicates were found for several reasons: lack of collection overlap, unstandard data on batch records, and different field sizes.
2. Therefore, computer programs were written to convert the batch records to upper- and lower-case and to enlarge field sizes. Examples of this computer editing included: (1) expanding author, title, series, collation, and subject heading field size; (2) converting all letters to lower-case except those in selected fields which followed punctuation; and (3) deriving a three-letter "Cutter" from the first three letters of the author's last name to replace the regular Cutter.

No computer duplicate test was made since librarians feared that nonstandard data from the batch system would prove misleading. Non-standard data had resulted from using variable abbreviations and "... " to indicated omitted information on too-small batch fields.

3. Title lists for all 55,000 records were printed; all bibliographic data was in the new, converted format. Catalogers then edited the lists for duplicates and for inaccurate data.

4. Terminal operators keyed in the revised data. Records were either updated and the correct number of copies added or they were deactivated.

The above steps took from July 1970 through February 1971 to complete. Out of 45,000 records, almost 30,000 were transferred to the FASTER files. The rest were dropped as redundant or erroneous.

A large backlog of new materials accumulated while the file merger continued. However, the then-director of Libraries and Administrative Services, realized that the merged data base was necessary if the cost benefits of a high duplicate rate were to be realized later. The file merger utilized one supervisor, three catalogers, and seven terminal operators during seven months. Three terminals were used in August, six in December, and eight were in operation during February 1971.

After working elbow deep in the merged file for seven months, both catalogers and operators had confidence in its contents. Catalogers had long recognized several imperfections in the batch system's data, such as unstandard data and cryptic information. The file merging process required that they examine each bibliographic and copy record carefully. Long-postponed standardization of subject headings, publisher names, and author names (personal and corporate) were some by-products of their scrutiny.

The LTP staff's new confidence in the cataloging data spread to confidence in the system. The combination of reliable data and ease in manipulating it via terminal resulted in LTP unit taking ownership of the new system. Change in ownership from designers to operators is a requirement for any viable automated system.

In April 1971, the new director of library services realized that Library Technical Processing, just emerging from its tedious file merger, needed relief. Therefore, book processing arrangements for fiscal year 1971-72 were made with a jobber for all but one elementary school, which elected to stay with LTP.

With almost all elementary book items diverted to the jobber, LTP proceeded during the summer of 1971 to demolish its backlog of approximately 32,000 items by utilizing eight terminals twelve hours per day with double shifts from mid-June through mid-August. Monthly production statistics show 13,250 new items processed in June; 14,342 in July; and 12,482 in August. At this production rate the backlog was removed and incoming new materials were processed.

Fig. 1 shows cumulative file size since December 1971. Preoccupation with the file merger is revealed by the small increment in new titles processed between December 31, 1970 and the end of the first quarter of 1971.

Since September 1971, LTP has been able to process all incoming secondary materials with no backlogs. This system capacity allowed for the return of all elementary processing to LTP as of July 1972. In the meantime, however, LTP has processed shelflists of older holdings on a time-available basis, resulting in a steadily growing rate of retrospective conversion.

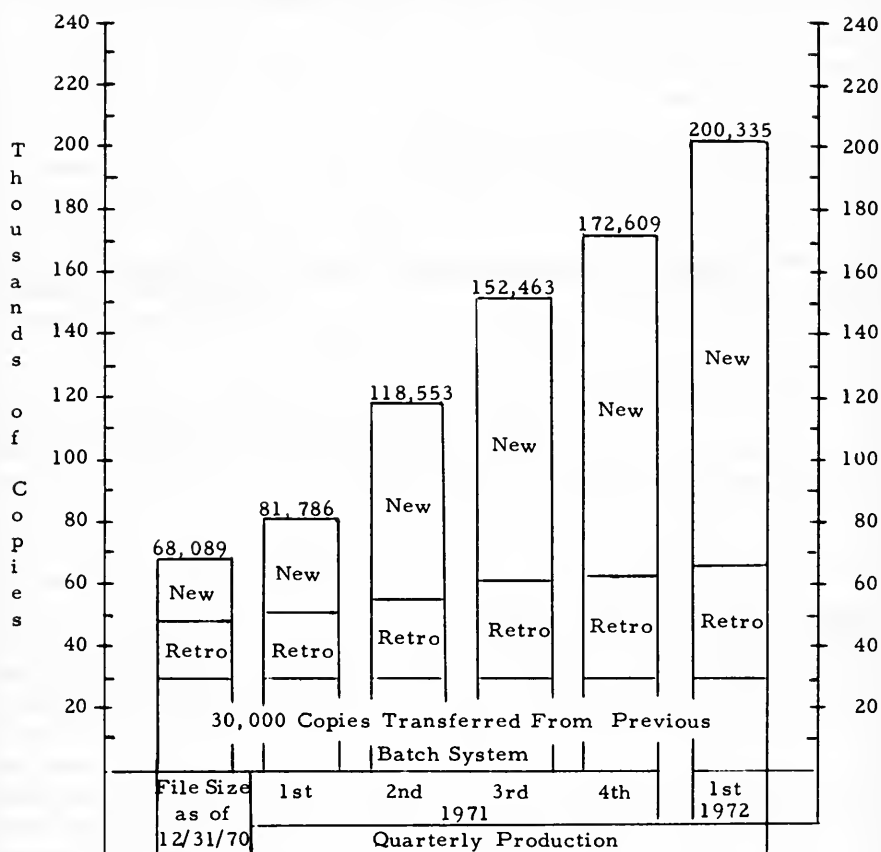


Fig. 1. Total Number of New, Retrospective and Transferred Items in Master Cataloging File

### Retrospective Conversion

Several ways of converting shelflists have been tried during the past two years. The major variables have been: (1) the degree to which the shelflist is compared with actual holdings before a duplicate search is attempted via terminals; (2) location of terminals in LTP or the school libraries; (3) which staff—LTP or building—examines computer-sorted and printed card catalogs and applies new labels; and (4) whether card catalogs and labels are sorted and printed at the end of conversion, or printed on demand during retrospective conversion.

To date, one secondary and two elementary schools have been completely converted from shelflists. Two secondary schools are now in progress on a time-available basis. This leisurely approach explains the relatively small

increment in retrospective items in fig. 1. All incoming items have higher processing priority than any retrospective items.

Experience with five schools has shown that a careful comparison of the shelflist with actual holdings is very useful before attempting a duplicate search via terminal. If this step is not taken, inaccurate copy information, missing shelflist cards and poor shelflist data appear. These problems are especially likely in a school system which had for years relied upon cataloging by busy librarians and volunteers; some of the latter not highly trained or supervised.

Printing cards and labels is flexible. Librarians can choose massively sorted and printed card catalogs, and massively printed label sets in shelflist sequence. Or, they can request item-by-item cards and labels as conversion proceeds. The intent of library management is to provide as responsive an output schedule as possible.

However, decisions must be made well in advance of the deadline for output. Sort and print time for a large card catalog is considerable; the large number of Shawnee Mission computer applications<sup>2</sup> requires that the Division of Library Services puts its bid in early to the computer center for large chunks of computer time.

Several manpower options for relabeling and for checking entire card catalogs have been used. One secondary school requested cards to be printed in small clusters by Dewey number; that school's librarians did all filing and replacing of old card files. Two elementary school libraries let LTP staff examine and refile the massively printed card catalogs, and relabel the collection. One junior high school used parent and student volunteers to relabel the collection. In one instance, the terminal was located in a secondary school. The operator worked with the librarians in performing a duplicate search, adding copies for those duplicates, and keying in entire records for new items.

At the end of March 1972, a total of 36,718 retrospective items had been added to the master copy file; 18,629 were in the file by January 1, 1971. Included are entire collections as well as individual items sent in by librarians; in earlier years some audiovisual items were not cataloged by overloaded librarians. The on-line system has the capacity to process these older items on a time-available basis, and several librarians have taken advantage of this service. One example is the 1,500 film strips submitted to LTP in February 1972 by an elementary library; that work was still in process as of March 1972.

LTP staff consider retrospective conversion a good way to keep the terminals busy. However, operators tend to become bored by several hours of keying from shelflist cards because transaction response time, averaging six seconds between hitting the bid key and starting to type the response, is too long. Normally, an operator inputting books and audiovisual items scans them

while waiting for the computer to respond. Since there is nothing of interest to scan on shelflist cards, operators may get bored.

Retrospective conversion is an excellent filler for a high capacity on-line cataloging system, but it may cause impatience and frustration in operators when undertaken in lengthy stints.

## QUANTITATIVE DESCRIPTION

### Total File Characteristics

A total of 200,335 copies and 78,113 titles are held in the Shawnee Mission on-line library files. Table 1 presents data for each type of physical format currently processed by LTP.<sup>3</sup> Books represent 76 percent of all copy records, compared to 74 percent of all title records. Of the 200,335 copy records, 47,280 are for audiovisual items. There are 20,138 unique audiovisual titles among the 78,113 title records.

The overall duplicate ratio is 2.58 to each new title. This desirable ratio is important for cost reasons: highly paid catalogers are not needed to handle duplicates, fewer terminal transactions are needed to enter each duplicate, and duplicates move through LTP more quickly.

### System Efficiency

"Efficiency" connotes speed, accuracy, and economy. That definition applies to the Shawnee Mission on-line cataloging system.

### COSTS

When cost data were compiled in the summer of 1970,<sup>4</sup> the authors did not anticipate the heavy use that would later be made of listings, statistical reports, bibliographies, entire card catalogs and label sets, and other printed products. Therefore, two sets of cost data were computed for this paper. Table 2 shows unit cost estimates for card/label output only, which is comparable with the figures of 1969-70. It also gives unit cost estimates which include the present high rate of auxiliary printing.

Costs in table 2 are based on: 1) tasks performed at LTP from item arrival to mailing out to the destination library, 2) library and data processing staff, 3) computer time, and 4) supplies.

A junior high school which requested an entirely new public catalog, shelflist, and set of labels exemplifies the importance of auxiliary printing. Its collection had been added to the batch system; later, the librarian desired uniform printed products from the upper- and lower-case system. An example of another product for which auxiliary printing is needed is the union catalog for all 16mm films, organized by title and subject headings, which will be placed in buildings for teacher and librarian use.

<i>Physical Format</i>	<i>Copies</i>	<i>Titles</i>
Art prints	1751	958
Books	153055	57500
Charts	94	79
Cassette recordings	938	549
Disc recordings	5438	2743
Flash cards	53	19
Filmstrips	20401	7609
Games	156	115
Globes	9	8
Kits	224	140
Super 8 loop films	4520	1990
Sound loops	20	8
Models	66	65
16mm films	901	793
Maps	66	62
Realia	10	9
Sound filmstrips	5638	2061
Slides	925	425
Study prints	1791	475
Sound slides	69	28
Tape recordings	1533	1095
Transparencies	2430	1199
Viewmaster reels	245	181
Collections	2	2
Total	200,335	78,113

**Table 1. Total Copies and Titles for  
Each Physical Format (As of March 10, 1972)**

	<i>Card &amp; Label Sets Only</i>	<i>Card &amp; Label Sets and All Other Printed Products</i>
Any Item	\$2.25	\$2.53
Duplicate	1.91	2.15
New to system	4.36	4.91

**Table 2. Estimated Unit Costs for  
Fiscal Year 1971-72**

A large data base encourages a large amount of auxiliary printing. Therefore, cost data should reflect both original data entry and basic cards/label output, and later use in many printed products.

### AVAILABILITY

Availability is a very important measure of system performance. Specifically, availability means the ratio of downtime to total hours scheduled for operation. Data kept from July 1 through December 31, 1971, reveal a highly dependable on-line cataloging system.

During that period the system was scheduled for 8,280 terminal hours. In reality, it was down for 880 hours. Of that downtime, 672 hours were for weekly preventative maintenance on the System 360. The remaining 208 hours of downtime were due to other causes, including quarterly system dedication to grade reporting.

Thus, the system was down 10.6 percent of its scheduled time. Downtime for other than preventative maintenance accounted for 2.5 percent of the 8,280 hours during those six months. This high rate of system availability is especially significant because another teleprocessing system, APL, runs concurrently with the library FASTER system. In the third core partition, batch jobs are also processed.

### DATA QUALITY

One area lacking dependable statistics is the correction rate for on-line data. Since no count is made of, or can be derived for, corrections, estimates must be used. The usual caveats accompany the following statements from LTP personnel.

LTP staff estimates that 1/10 full time equivalent terminal operator corrects erroneous data found on cards, labels, or any other output. Generally errors are spotted by the clerks who match cards/labels with each item. Suspected errors are turned over to the terminal supervisor, who consults with catalogers when necessary. Currently, only one terminal operator actually keys corrections. However, one operator spent about 75 percent of her time on corrections when a second shift of operators was added during July and August 1971.

### RESPONSE TIME

Another area lacking reliable statistics is transaction response time. Since it was impossible to construct average transaction time from the computer center, the authors timed individual operators with a stop watch. Specifically, the interval between hitting the bid key and receiving a reply was timed. At the time this small, statistically unreliable study was made, all six terminals were operating along with the other teleprocessing system and batch jobs. The

<i>Week Tagged</i>	<i>Number of Items</i>	<i>Week Completed</i>				<i>Total</i>
		<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	
1	1,326	0	0	39	576	615
2	1,000		0	40	169	209
3	543			0	11	11
Total	2,869	0	0	79	756	835

**Table 3. Number of Items Completely Processed  
During Throughput Study**

average for seventy-nine transactions was six seconds, ranging from three to sixteen seconds.

#### THROUGHPUT TIME

Another measure of system efficiency is the time taken for new acquisitions to be processed. In order to study that throughput time, new acquisitions were monitored during a four-week period, March 13 through April 7, 1972.

The method used included: (1) inserting different colored tags into audio-visual and book materials, (2) stamping the date the item was compared with its purchase order (usually not more than one day later than actual delivery), (3) noting on each tag whether the item was a duplicate, and (4) pulling the dated tag out when the item was fully processed and being boxed for the building librarian. The number of completed tags was compared against the total number inserted. Tags were inserted during the first three weeks of the study; they were gathered when completed during weeks three and four. No tags were ready during weeks one or two, as seen below.

Table 3 shows the number of items that were completed during each of the study's four weeks. Of the 2,869 new acquisitions, 1,216 were audiovisual items and 1,653 were books; 188 of the 1,216 audiovisual items were completely processed during the study. Of those 188 audiovisual items processed, 182 were duplicates of titles already in the system. Thirty-eight percent of the 1,653 books were completed during the study. Of the 636 completed book items, 71 were new to the system; 565 were duplicates.

Fig. 2 shows the frequency distribution of elapsed working days between tagging and boxing for delivery to the building librarian. An average of one day preceded tagging; tags were inserted when the item was compared with its purchase order.



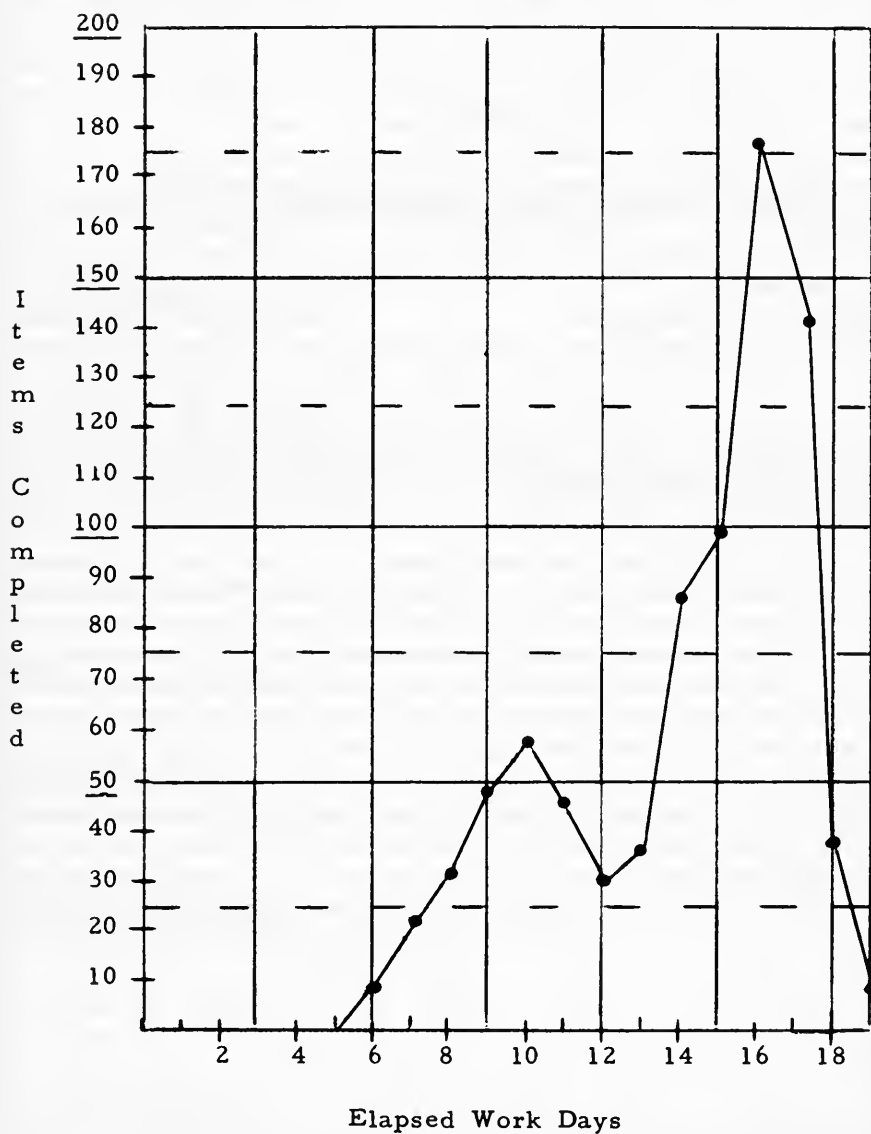


Fig. 2. Work Days Needed to Process 835 Book and Audiovisual Items During a 19-day Study

A full-capacity staff in Library Technical Processing for data entry, cataloging, and physical preparation is six terminal operators, three catalogers, and six preparation clerks. During the first 2.5 weeks of the study, only one preparation clerk was on duty; the others were helping with priority tasks in the schools. During the last 1.5 weeks of the study an average of three preparation clerks were at LTP. The variable number of these clerks helps explain why no sample items were completed during the first two weeks—items already in the processing pipeline had to be completed by available LTP staff.

During week three, boxing for building librarians was performed twice, on Tuesday and Friday. Thus, tags could be retrieved only on those two days. Boxing occurred each day during the fourth week of the study.

The fluctuations in manpower symbolize the responsive method of library management used at Shawnee Mission. Instead of assigning staff to permanent positions, clerks and professionals perform tasks as needed—whether at LTP or in school libraries.

### File Usage

Title and copy file usage measures their data's relevancy to library needs. Of the scheduled printed products, approximately 83,700 card and label sets were printed during fiscal year 1971-72 for new items. Terminal transaction statistics are printed weekly, LTP production tallies for each building monthly, and statistics on active title records monthly.

School librarians and the library management also request specific listings on demand. One union catalog for 901 16mm films has been printed; it consists of a 57-page title index and a 54-page subject index.

During the five months beginning November 1, 1971, twenty inventories of school holdings were run; sort and print time for the programs involved took 29 hours and 17 minutes. During the same period eight union subject heading bibliographies were compiled by the computer. Total run time for those eight bibliographies was 9 hours and 42 minutes.

There are two on-line file query transactions: (1) by title number, and (2) by author last name and title. Table 4 shows the rate for each type of file query, and the proportion of the two query transactions to total transactions.

In general, the author/title query is used to find duplicates among new acquisitions. The title number query is used to enter additional copies and to complete bibliographic data for new-to-the-system titles.

### Daily Operations

As of March 1972, six operators work weekdays from 8:00 A.M. to 4:30 P.M. Coffee breaks and lunch periods are taken, of course; there is no operator

<i>Terminal Transactions</i>	<i>Fourth Quarter 1971</i>		<i>First Quarter 1972</i>	
	<i>Number</i>	<i>% of Total Transactions</i>	<i>Number</i>	<i>% of Total Transactions</i>
Title Number Query	24,876	22	18,813	16
Author/Title Query	15,815	14	22,685	18
All Library Transactions	114,186		120,908	

**Table 4. Rate of Terminal Transactions upon the Title and Copy Files**

backup for those relief periods. Absentee backup is provided by the terminal supervisor, who also checks newly printed cards and labels, and identifies corrections for operators. No overtime or weekend hours are currently scheduled.

Monthly production from this work force averages 8,400 new and retrospective items. On the average, each operator processes 1,400 items per month, or 350 per week. Absences and downtime affect production; another variable is the arrival rate of new items. The current batch order system prints orders bimonthly, resulting in a fairly steady flow of new acquisitions to LTP.

Twenty-one LTP staff receive, catalog, enter, and process new and retrospective items. They also handle all jobs connected with the 16mm film library. Two staff are certified teachers, the rest are clerks. LTP processes items for the sixty-five Shawnee Mission schools as well as for fifteen other locations, including professional collections and several parochial schools.

## MANAGEMENT IMPLICATIONS

The Shawnee Mission Public School District has undergone some significant management changes since June 1969. Affecting problemsolving and budget-making are many variables including: (1) unifying thirteen small districts in July 1969; (2) providing management expertise for the resulting K-12 system with sixty-five schools and 44,000 students; (3) adopting middle-management decisionmaking systems; and (4) living with a Kansas State property tax lid that allows no more than 5 percent annual increase in operating funds.

Changes in the environment and composition of the new unified district required different approaches to problemsolving. The on-line cataloging system was carefully watched by top management, who followed up that positive experience with team-operated system design in other areas, notably accounting and budgetmaking.

## Development

The following section presents the authors' views on several levels of management development in the Shawnee Mission School District.

### MANAGEMENT OF THE ON-LINE PILOT PROJECT

The authors believe that the management of pilot project implementation was generally satisfactory although inexperience led to one major miscalculation about the amount of time needed and the method chosen for editing the batch records to expanded, upper- and lower-case format. Recognizing the importance of file merger, our direct control of the pilot project should have continued until it was completed. Instead, there was no strong control of the file merger, especially in its initial stages. That lack of task management probably lengthened the time taken for the file merger.

### LIBRARY MANAGEMENT

That we were soon reassigned to other, nonlibrary projects meant that the LTP staff quickly claimed ownership of the on-line system. Any new system's viability depends, of course, on the users' psychological identification with that system. The seven months spent merging the file helped LTP staff to identify with and own the on-line system.

The same cannot be said for school librarians during that period, however, since relatively few new materials trickled through the backlog into their buildings. The decision to send elementary orders to a commercial jobber for processing was, therefore, a wise one. Both groups of librarians—LTP and the school librarians—found library management responsive to their different needs.

Unit costs decreased from the batch system to the on-line system. While unit costs for any automated system are probably higher than manual processing, the additional use of the data through file query and auxiliary printing is significant. Indeed, the two major future projects for the library system draw heavily upon the growing data base: (1) on-line control for the booking and circulation of the 16mm film collection, and (2) special bibliographies for use by subject areas such as seventh grade unified studies.

Perhaps most important for the building librarian, improvements in the cataloging and order systems during the past two years have resulted in decreased throughput time for new orders. Two years ago it was not unusual for 12-18 months to elapse between submitting a request and receiving the item. Currently, that time is estimated to be about three months. The on-line system has cut the processing time of new acquisitions; additional savings of time will be possible with a revised order system, scheduled to begin operation in 1973.

## DATA PROCESSING MANAGEMENT

The on-line library system has achieved that highly desirable division of labor between any data processing installation and its users: users have full responsibility for data quality and format while data processing guarantees data and file safety. This relationship is especially appreciated at Shawnee Mission, where programmers previously worked daily with library data in the previous batch system.

The success of two teleprocessing systems—student-oriented APL and library FASTER—has encouraged other district offices to request teleprocessing. Significantly, educators now requesting this service realize that it must be accompanied by more core, better central processing unit-disk turnaround time, and more disk storage. These traditional computer mysteries are becoming the property of educators, whose growing sophistication helps the computer center explain and expand its current applications.

One implication of more teleprocessing applications may be a role change for programmers. The bulk of system programming is usually done prior to starting a teleprocessing system. After the system is up, programming efforts tend to shift to general software maintenance rather than application maintenance.

## TOP MANAGEMENT

Top management continued its experiment with team assignments when the authors were asked to participate with data processing and business office staff in setting up a cost-centered accounting system. The subsequent success of the accounting system was due in large part to the business office staff assuming ownership and file control.

As a result the business manager can say with confidence that he knows the latest status of all district expenditures. By pursuing proven methods of team problemsolving, top management gained a middle level staff expertise that continues to be utilized. The resulting staff skills are usable in many parts of the school district.

The on-line cataloging system's interest in providing production and operations statistics has been carried much further during the past fiscal year. The business office now prepares a semiannual budget report showing all expenditures cost centered to specific locations and programs.<sup>5</sup> Information about costs, production, and operation for any part of the school district is consistent with the movement to inform and utilize middle management. Without information, middle managers cannot participate fully in problem detection and problem-solving.

Shawnee Mission's cost-centered accounting system aided in contracting with two national companies to provide audit and computer hardware services. These companies can compare Shawnee Mission's development

with national trends and local staff can benefit from their state-of-the-art knowledge about educational management.

Finally, the successes of both the library system and the accounting system have provided national publicity for this school district. A summary article written by the superintendent of schools was published in 1971.<sup>2</sup> The coordinator of public information has provided the local media with stories and interviews. Needless to say, top management of school districts—like that in any sector of the economy—likes favorable publicity on innovative programs. The fact that no grant funds of any type have been used in these projects has enhanced top management's ownership.

Throughout this section on management implications is discussion of the changes that Shawnee Mission School District has undergone since unification in July 1969. Since then, ownership of the management process has spread to middle level administrators. Why? They have been encouraged to detect and solve problems; more important, top management has continued to utilize their new skills. By participating in decisionmaking committees, such as the budget review committee which creates a district-wide draft budget, school principals and directors are becoming the critical management cadre upon which future improvements depend. It is intended that such decentralization will result in even more vital and relevant services being rendered to the community by Shawnee Mission Public Schools.

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## A User's View of BALLOTS

BALLOTS (Bibliographic Automation of Large Library Operations using a Time-sharing System) is an on-line interactive library automation system that supports the acquisition and cataloging functions of the Stanford University Libraries' technical processing operations. The BALLOTS system is being implemented in a series of eleven modules. A large part of BALLOTS' development up to the development of the first module was funded by a grant from the U.S. Office of Education, Department of Health, Education, and Welfare. This paper describes the first module, BALLOTS-MARC (or simply, the MARC module), and various aspects of system hardware and software as they pertain to this module. The MARC module was scheduled for implementation in the late summer of 1972. The other modules are briefly described at the end of this paper.

The MARC module supports the production of purchase orders, catalog card sets, spine labels, and several types of file slips and management reports. An on-line MARC file stored on disk is updated from the weekly Library of Congress MARC tapes. Several indexes are maintained in the file in order to support extensive on-line interactive file searching.

The BALLOTS system operates through programmable cathode ray tube (CRT) terminals in the library that are connected to the campus facility, an IBM 360 Model 67 computer in the Stanford Computation Center, approximately one mile away. The campus facility computer also handles the faculty



Fig. 1. The Sanders PDS 804 Programmable CRT Terminal

and student academic and research computing requirements. About 2,000 computing jobs unrelated to **BALLOTS** are run on this computer each day.

The type of video display terminal being used for **BALLOTS** is shown in fig. 1. It consists of a keyboard, a CRT capable of displaying 1,920 characters at a time, and a 4,096-byte programmable microprocessor. The CRT terminal could be called a window into the **BALLOTS** system; through it the library communicates with the system. Printed outputs, like the purchase orders, catalog cards, and spine labels, are produced overnight as a result of the daily on-line activity at the terminal.

One way of describing **BALLOTS** is to explain how the system looks to the user and how it is used in normal day-to-day library operations. A typical book cycle will be traced in the examples that follow.

## SEARCHING

A typical book processing cycle begins when the acquisition department receives a book request from a faculty or staff member requesting that a particular book be added to the collection. A sample book request is shown in



Author		White, Jon M.		<b>RUSH</b>	
Title		Cortes and the Downfall of the Aztec Empire			
Edition		Place	Publisher		
		New York	St. Martin's Press		
Date of Publication		No. Vols.	Series		
1971					
No. Cop.	Price				
2					
Req. by	JMB	Order From:	Other Info.:		
Dept.	RDP				
Fund		Abel			
Acct. No.	NKA-004				
Shelve	Stack, 1A4	Cat.:	Item:		
Searcher:		Date:			

Fig. 2. Book Request

fig. 2. On receiving the book request, the librarian keys in a search request for that particular book at the CRT terminal keyboard. This search request, shown shaded in fig. 3, is displayed on the CRT screen as it is keyed. (In the following figures, all the data supplied by the terminal operator is shown shaded; all the data supplied by the computer is shown unshaded.) The operator in this example chose to search (FIND or FIN) by one personal name (PN), and because he was unsure of the spelling of the author's name (JON or JOHN), typed J. instead. The operator chose two words from the title. Because he was unsure of the spelling of CORTES, he truncated the word to CORTE#, which would locate a record for any title word beginning with "Corte."

The search request is entered into the system, the on-line MARC file is searched, and the search results are returned to the screen in about two seconds. In the BALLOTS system, when only one record is found in a search, it is assumed that this record is the correct result, and the full bibliographic record is displayed at the terminal (fig. 4).

Searching can be done using any word or words in the title (trivial words, like THE and IN, will be recorded in an exclusion list for the file, and the system will reject them as search terms). One can also search using the LC card number, the main entry, the title statement, and added entries. And the personal name can be given to the system in various forms. For instance, in fig. 4 the author's name turned out to be stored in the MARC file as

S101	BMRC-S	ORDER	S	WED
fin pn J. M. White and t Cortes and Aztec				

Fig. 3. A Search Request on the S101 Screen

BF01	BMRC-S	72140589	ORDER	S	WED
fin pn J.M. White and t Cortes and Aztec			RESULT:	1 BOOK(S)	
OR01					
White, Jon Ewbank Manchip, 1924-					
Cortes and the downfall of the Aztec Empire; a study in a conflict of					
cultures, by Jon Manchip White. New York, St. Martin's Press [1971]					
352 p. illus., maps, plans, ports. 25 cm. \$10.00					
Bibliography: p. [335]-339.					
1. Mexico - History - Conquest, 1519-1540. 2. Cortes, Hernando, 1485-1547.					
I. TITLE.					
72-140589					
F1230.W46 1971 972/.02/0924					
CP:nyu L:eng REC:am MS:N					

Fig. 4. A Full Bibliographic Display on the BF01 Screen

WHITE, JON EWBANK MANCHIP. The following variations on this name, or any combination of them, would also be accepted as valid search terms and would locate the same record.

WHITE, J.E.M.	(initials)
White, M.	(some initials omitted)
White, J E M	(initials without periods)
white, jon ewbank manchip	(capitalization ignored)
J.E.M. White	(surname first or last)
Manchip White, J.E.	(surname first or embedded)
White, Jo Ewb Man	(first names implicit truncation)
Whi#, J.E.M.	(last name explicit truncation through use of pound sign)

The BALLOTS system makes extensive efforts to recognize different versions of a personal name, because in many of the library processing cycles the exact name of an author is not known. This helps to insure success in on-line search efforts.

If the search in fig. 3 had been entered as simply FIN PN J. M. WHITE, the search might have produced more than one result (because more than one record in the data base fulfilled the search criteria). In this case (fig. 5), the

```

S102          BMRC-S          ORDER      S      WED
fin pn J. M. White      RESULT:      5 BOOK(S)

```

Fig. 5. Search Results Displayed on the S102 Screen

```

S102          BMRC-S          ORDER      S      WED
fin pn J. M. White      RESULT:      5 BOOK(S)
[Redacted text]

```

Fig. 6. Interactive Searching on the S102 Screen

results would be displayed as a numerical total of the number of records found, rather than the first of these records being displayed in its entirety. Fig. 5 shows a total of five records found that meet the search criteria. The librarian now has the choice of asking for each of the full bibliographic records to be displayed in turn, or of keying additional search criteria that, when added to the previous search request, would reduce the number of records found. This second option is shown in Fig. 6. Such iterative searching would produce the same result as displayed in fig. 4. Figs. 5 and 6 illustrate (very simply) the interactive searching capabilities of the system.

## ORDERING

If the search described in the previous section has produced the desired record, and the library decides to order the book, then the terminal operator requests an ordering (OR01) screen for the same bibliographic record. This is shown in fig. 7. The terminal operator fills in the appropriate information: vendor data, accounting data, and enough additional information to produce a purchase order. In fig. 7, the values in the unshaded fields were supplied by the system as default options: PO (purchase order) for the method of procurement, 01 for the address code (stands for Stanford University), 2 for the special notification indicator (indicates that a notice is to be sent to the requester when the material is received), and WED for the searcher's initials. The system also supplied a request for one copy (1 c.) and the price (\$10.00), but the operator has changed this to 2 c. and \$20.00.

```

OR01      BMRC-S      72140589      ORDER      S      WED

ENTER
PRO po /      ADD 01 /      CLT
X              NAN      PO
SNI 2 /      SO      SI WED /
MDX  /
PR 3 / 00
RAC  /      SHE  /
R-  /
RSD  /
RCS  /
V-  /
VSD  /
VCS  /
VSP  /
VCT  /
CAT  /
DRM  /
ACQ  /
N-  /
NSD  /
NCS  /

```

Fig. 7. Preparing a Purchase Order on the OR01 Screen

```

OR01      BMRC-S      72140589      ORDER      S      WED

ENTER
04 RAC NK 004 /      05 SHE  /
R- I JMB
RSD  /
RCS  /
04 V- I Ah /
VSD  /
VCS  /
VSP  /
VCT  /
CAT RUSH
DRM  /
ACQ  /
N-  /
NSD  /
NCS  /

```

Fig. 8. Corrected Ordering Screen

Many of the items on this screen are coded, since a considerable amount of repetitive data is involved in the day-to-day use of this screen. For instance, instead of putting in a specific vendor's name, a vendor ID is entered; the system uses this ID to look up the vendor's name and address in another file.

S101  
ENTRY PROCESSED

BMRC-S

ORDER

S

WED

Fig. 9. Order Screen Accepted, Return to Begin Search Screen

In the example shown in fig. 7 there are three errors in the input. When the operator has decided that the ordering information is complete and has transmitted this information to the computer (by depressing the SEND button on the keyboard), BALLOTS programs perform on-line editing of all the data elements on the screen. As part of this, for instance, the budget account code (BAC) is scanned and the codes and values file is searched: this check reveals that the data contains an invalid code. As a result, the ordering screen is returned to the user. An error code, indicating the invalid code, appears on the screen preceding the BAC field. Error codes are also returned to the operator indicating that the vendor ID is an invalid code and that a field where a data element value is required is blank (the shelving location field—SHE). When the screen is edited, the system moves the first line containing an error up to the position of fourth line on the screen. The correct lines above it are not displayed. When these errors have been corrected (see fig. 8), the screen is sent a second time to the computer and the data is then accepted.

Once the final screen needed to perform a function is accepted by the system, the transaction is considered complete and the system prompts the terminal operator to go on to another activity by responding ENTRY PROCESSED (see fig. 9). As a result of the successful on-line activity shown in figs. 3-9, several outputs are printed overnight in the computer batch partition. These outputs are the purchase order (fig. 10), a catalog work slip (fig. 11) for use by the catalog department when the book arrives, and a temporary order slip (fig. 12) for use by the acquisition department.

We have looked at a typical BALLOTS ordering cycle. The cataloging cycle consists of a similar sequence of searching, input (using some different screens), and output. This cycle will be discussed in a later section.

## THE PROGRAMMABLE CRT TERMINAL AND BALLOTS SOFTWARE CAPABILITIES

Several basic functions of the BALLOTS system were demonstrated in the activities just described. But this interaction between the user and the CRT terminal is only the tip of the iceberg that is the BALLOTS system. Having looked at some initial uses of BALLOTS, we can now go a little further into some components of the system.

STANFORD UNIVERSITY LIBRARIES		PURCHASE ORDER		DATE OF ORDER	ORDER NO
NO COPIES		[REDACTED]		10/13/72	72140589
2		White, Jon Ewbank Manchip, 1924- Cortes and the downfall of the Aztec Empire; a study in a conflict of cultures, by Jon Manchip White. New York, St. Martin's Press [1971]			
				SHIP AND BILL IN DUPLICATE TO: Order Division Stanford University Libraries Stanford, CA 94305	
TOTAL EST. PRICE		\$20.00		VENDOR NO Abel	
DEALER LEAVE BLANK		INV. DATE	LP	NP	STX
					SP
DEALER: SEE OTHER SIDE					

Fig. 10. Purchase Order

CATALOG WORK SLIP	72140589
F1230.1/46 1971	STK
RUSH	
White, Jon Ewbank Manchip, 1924- Cortes and the downfall of the Aztec Empire; a study in a conflict of cultures, by Jon Manchip White. New York, St. Martin's Press [1971] 352 p. illus., maps, plans, ports. 25 cm.  Bibliography: p. [335]-339.  1. Mexico - History - Conquest, 1519-1540. 2. Cortes, Hernando, 1485-1547. 1. TITLE. DC:972/.02/0924 MS:N	

Fig. 11. Catalog Workslip

The terminal used in the BALLOTS system is the Sanders PDS 804 programmable CRT terminal. This terminal includes a microprocessor in its hardware that permits specific computer programs to be loaded directly into the CRT terminal. These programs control the display of data entered at the keyboard and the communication of the terminal with the main computer. The Sanders CRT terminal can display 1,920 upper- and lower-case characters on a screen, in 24 eighty-character lines. The BALLOTS development staff

ORDER FILE	10/13/72	72140589
White, Jon Ewbank Manchip, 1924-		
Cortes and the downfall of the Aztec Empire; a study in a conflict of cultures, by Jon Manchip White. New York, St. Martin's Press [1971]		
F1230.W46 1971		
2 c.		
VENDOR: Abel		\$20.00
PRO: po	REQ. BY:	SN1: 2
SHIP TO: 01 WED	James Breedlove	
STK NKA004	Resources Development Program	
REC'D:	Main Library	

Fig. 12. Order Slip

were able to assign specific functions to certain keys (such as the paging keys—see the last paragraph under “Protocols and Commands” section), to adapt the Sanders terminal to the uses of the system even further.

The BALLOTS terminal is programmed so that specified segments of lines on the screen or ranges of lines on the screen can be considered as single data element fields. These fields may be either protected or unprotected. A protected field is one in which the user cannot input data, although the system may display data there. During input at the keyboard, the cursor is prevented from entering protected fields; this constraint is part of the control program loaded in the terminal. (The cursor is a fast-blinking underline character that indicates to the user his position on the screen.) When the user is typing data in a field, he cannot type past that field into another field unless a CR (carriage return) or TAB key is depressed. A CR will move the cursor to the first input position on the next line; a lowercase TAB will move the cursor to the first input position of the next field (which may be on the same line or the next line). An upper-case TAB moves the cursor back to the beginning of the current field. If the cursor is already at the beginning of the field, it is moved to the beginning of the previous input field.

It should be pointed out that all of the features described here are programmed into the terminal and are not part of the hardwired logic of the terminal. This flexibility was one of the primary reasons for choosing the Sanders programmable terminal.

There are two types of input fields in the **BALLOTS** system. One is a fixed length field and the other is an expandable field. In a fixed length field, the amount of space is predetermined, and only the maximum number of characters allowed for that field may be entered. If the user continues typing, the cursor will not move to the next field, but will remain at the last character position in the current field. Each additional character input will simply overlie the previous last character. The only way to get to the next field is to hit a **TAB** or **CR** key.

If data are being input to an expandable field and there is not enough room preallocated on the screen, the user keeps typing. As soon as the first character beyond the current end of the field is keyed, the microprocessor recognizes this and immediately inserts a blank line following the overflowing field, so that the continued data is input in this new line. (An expandable field always extends to the end of the line.) All the lines on the screen below the overflowing field are consequently pushed down one line on the screen, whether they are protected (the cursor cannot enter them during input) or unprotected (the user may alter their contents). Thus the user need not watch the screen to see where the "end" of an expandable field falls, since the computer will provide however much space is needed to input all the data.

Sometimes, when an input field expands beyond a single line, the last word on a line may be split and continued on the next line. Although this presents no problem for the computer software, it is difficult for the user visually to verify the screen and is aesthetically displeasing. The microprocessor software will therefore automatically adjust the data in the field, reconnecting the broken word by moving the first half of the word from the previous line down to the succeeding line. This adjustment takes place as the user is keying data.

## SCREEN FORMATS

Given these basic features of the terminal software, we can look at the actual screen format developed for **BALLOTS**. The ordering (**OR01**) screen (fig. 7) is the example used; but the rules and methods described here apply to all of the **BALLOTS** screens.

1. The first horizontal line of the screen is called the control line; it consists of the following fields:
  - A. The first field is the screen identification: **OR01**. This ID identifies the screen format to both the user and the computer programs.
  - B. The second field is the file ID: **BMRC-S**. This ID notifies the user that the **BALLOTS-MARC** file for Stanford is being used in displaying the data.
  - C. The third field is the record ID: **72140589**. The search that preceded the use of the ordering screen obtained a specific title. The



record ID of this title in the MARC file is 72140589 (this is also its LC card number).

- D. The fourth field is the function code: ORDER. The user supplies this information, which describes the type of work the user will be performing (in this case, ordering). (The use of this field is described in the "Protocols and Commands" Section below.)
  - E. The fifth field is the library identification: S for Stanford University.
  - F. The sixth field in the control line is the terminal operator's initials: WED.
- 2. The second line on the screen is called the message line. This is used by the system to send messages to the user. In it the search argument is redisplayed, together with the search results (see figs. 4 and 5). Other possible messages include a warning that the system will be shut down in thirty minutes, or any other communication that is required from the computer system to the operator.
  - 3. The third line is the command line; it is used for communication from the terminal operator to the computer. This could be a request to conduct a specific search or to display a specific screen. An entire command language has been developed for the BALLOTS system that includes commands for searching, requests for screens, logging on and off the system, paging commands, etc. (Some of these commands will be discussed below.) Uses of the command line can be seen in figs. 3, 4, and 6. In fig. 3 the command line has been used to request a search; in fig. 4 it has been used to request an ordering screen; in fig. 6 it has been used to add parameters to the search in progress.
  - 4. The remaining lines on the ordering screen contain fixed length or expandable fields. If the fixed length fields are short, more than one field may be placed on the same line. This is shown in figs. 7 and 8. When a field is expandable, it must be the only field on a line. The CAT field is an example of this. The end of a field is shown on the screen by a ":". The temporary end of an expandable field is shown by a "'" in the last space on the line.

The first eight positions (character spaces) preceding each input field on the screen follow a consistent pattern. The first two positions are for the error code for the data element. If after a screen has been transmitted the on-line editing detects an error, an appropriate error code will be displayed in these first two positions (see fig. 8). Position 3 is usually protected, although it may be used by the operator in certain cases to indicate updated data elements. Positions 4, 5, 6, and 7 contain the data element mnemonics (right-justified). Position 8 is blank and protected. From position 9 to the "'" mark is the user input area. Some lines may contain more than one fixed length field. In these cases the position allowance is the same for error codes and mnemonics (see SHE on the BAC line in fig. 8).

## PROTOCOLS AND COMMANDS

An elaborate system of protocols has been developed in the **BALLOTS** system. A protocol is a logical sequence of operations performed at the CRT terminal, requiring specific screens. The function code in the control line (**ORDER** in the preceding example) determines which protocol the terminal operator will be following. These protocols prescribe the availability of screens and commands to various parts of the library. Some screens are used only for display; others are used for input and update. Someone in the acquisition department would not be making changes to the holdings portion of a record; therefore, the holdings (**HH01**) screen would not be available to that department. On the other hand, the acquisition department would use the ordering screen in order to input vendor information and pricing information; but the ordering screen would not be available to someone in the catalog department.

In addition to determining the uses of the various screens, the protocol system presents a logical sequence of screens to the terminal operator for each particular function. These screens are default options, and if the user does not request a variance, they are automatically displayed one after the other as each is successfully completed. For example, on the third line of fig. 4, the ordering protocol automatically supplies the next screen request for the ordering (**OR01**) screen; this is the default request following the display of a full bibliographic (**BF01**) screen.

A protocol map of the ordering function is shown in fig. 13. This is a simplified diagram representing the protocols (sequences of operations) possible in ordering. The default path is shown by the heavy line, and the available options are shown by light lines. The options available at any point in the protocol are shown on the horizontal line just below each CRT screen. For example, when the full bibliographic (**BF01**) screen is in use, the user may:

1. go directly to an ordering (**OR01**) screen (default option),
2. page to the next bibliographic record of several found in a search,
3. request a bibliographic input (**BI01**) screen,
4. request a supplementary input (**BI02**) screen,
5. begin a new search,
6. continue interactive searching (**SI02**), or
7. request a fresh search (**SI01**) screen.

Each protocol automatically displays certain commands in the third line of the screen; these can be changed by the user if the default option is not desired. (This will be illustrated below, in the "Cataloging" section.) There are several types of commands. One type tells the system which screen the operator wants to use next. These commands are simply the screen IDs (**SI01**, **HH01**, **BI01**, etc.) A second type instructs the system on how to handle the contents of the current set of screens. For example, the **ENTER** command

would cause all of the data elements on the current screen and on all previous screens used for the same bibliographic record to be processed and used to update the file. The CANCEL command would cancel all the steps taken so far by the current protocol.

A third type is the search commands. These commands use any of the available file indexes; search terms can be combined by using the logical operators AND, OR, NOT. An example of the first of these logical operators is shown in fig. 3. Here all three criteria must be satisfied in each record found. If the operator is not sure of a search term, he can input likely alternative terms using the OR operator. This approach will produce a larger number of search results. If the operator has determined certain elements that will not be part of the result he is after, he can include these following the logical operator AND NOT, and thus further refine his search criteria.

Paging commands are used to instruct the system to display additional data. If the contents of a particular bibliographic record are too large to be displayed on a single screen, these commands would allow the user to "page" forward (by displaying succeeding lines of the record) or backward through the record. This is accomplished by keying "+(P)" (for page forward) or "-(P)" (for page backward) in the command line. The BALLOTS CRT terminal has a special key to accomplish this. When a search has produced several bibliographic records, the operator may need to review each of the records found. By requesting a display of the first record and then paging forward to the other records, the operator could inspect the search results until he found the correct record. This is accomplished by keying "+B" (for next bibliographic record) or "-B" (for previous bibliographic record) in the command line. Again, the BALLOTS CRT terminal provides a special key to accomplish this.

There are many more commands in the BALLOTS system; they are described in the BALLOTS reports listed under "Selected References."

## CATALOGING

The searching and ordering cycles were described above in very simple terms. In describing the cataloging cycle, we can draw on some of the concepts since covered. Fig. 14, for instance, is a protocol map for the cataloging function.

Assume that the book ordered in "ORDERING" has been received and has been sent to the catalog department. This time, with book in hand, the operator (the cataloger) can key in a simpler search request. This request is shown in fig. 15 and consists of simply the find command, the index term mnemonic for LC card number (CRD), and the actual LC card number. (The index term refers to one of the indexes to the MARC file.) The hyphen in the number could be eliminated and the search request would still locate the

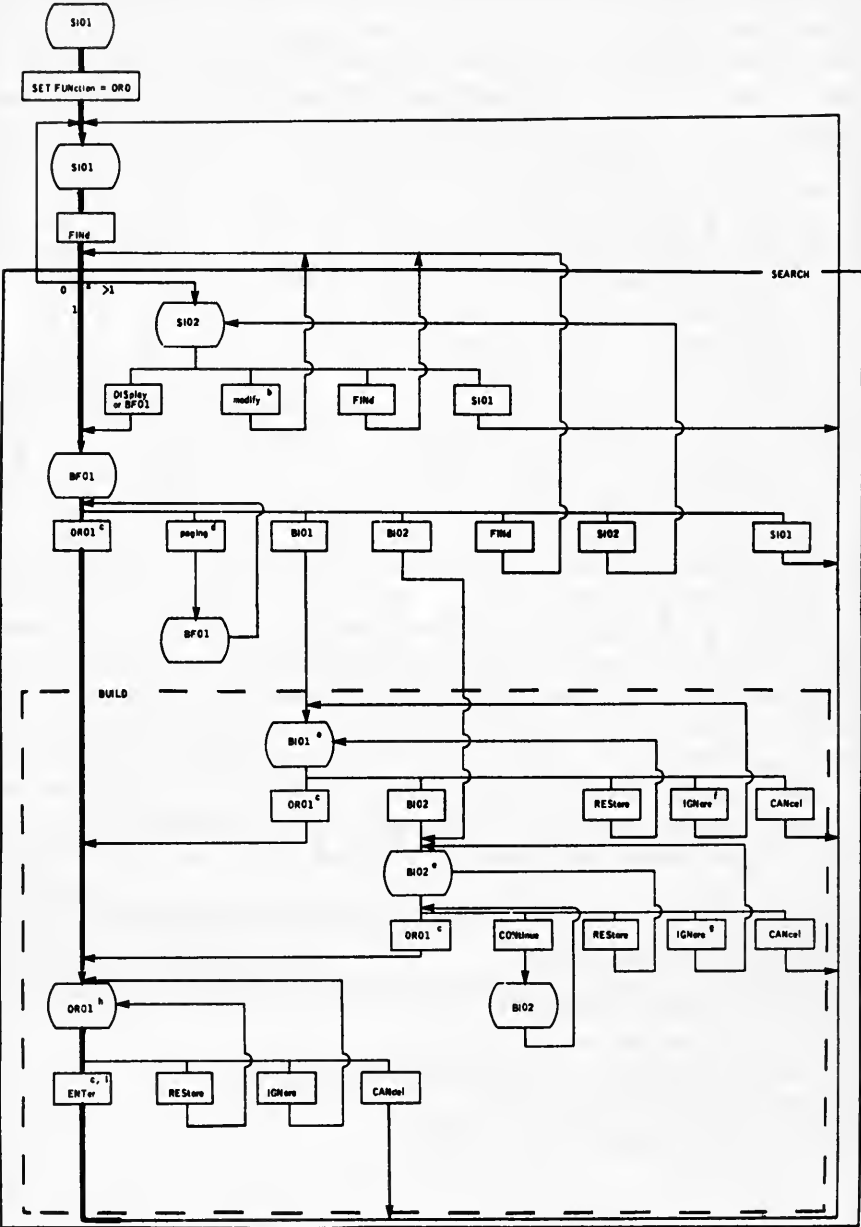


Fig. 13. Ordering Function Protocols for the MARC Module

- <sup>a</sup> At this point, the results determine the direction taken. If search results are zero, the operator is again presented with the S101 screen. If one record is found, it is displayed on the BF01 screen. If two or more records are found, the operator is told so on the S102 screen.
- <sup>b</sup> The FIND command can be modified through the use of Boolean operators. At each stage in the search, an up-to-date form of the search request is displayed in the message field of the screen. The operator does not repeat or rephrase the request already issued, but adds modifying criteria to it.
- <sup>c</sup> The default command, prompted in the screen's command line.
- <sup>d</sup> The actual commands are "+B" and "-B" for paging from one record to another, and "+(P)" and "-(P)" for paging within a record.
- <sup>e</sup> Optional screens. If they are not used, data is taken directly from the MARC file (BMRC) to produce outputs.
- <sup>f</sup> Here, "IGNore" could also be "IGN/B102" or "IGN/OR01."
- <sup>g</sup> Here, "IGNore" could also be "IGN/OR01."
- <sup>h</sup> Mandatory screen.
- <sup>i</sup> Here, "ENTER" could also be

  - "ENT/FIN<search request>"
  - "ENT/S101"
  - "ENT/S102"
  - "ENT/BF01"
  - "ENT/DIS"
  - "ENT/SET"
  - "ENT/LOGOFF."

Fig. 13. Ordering Function Protocols for the MARC Module (cont.)

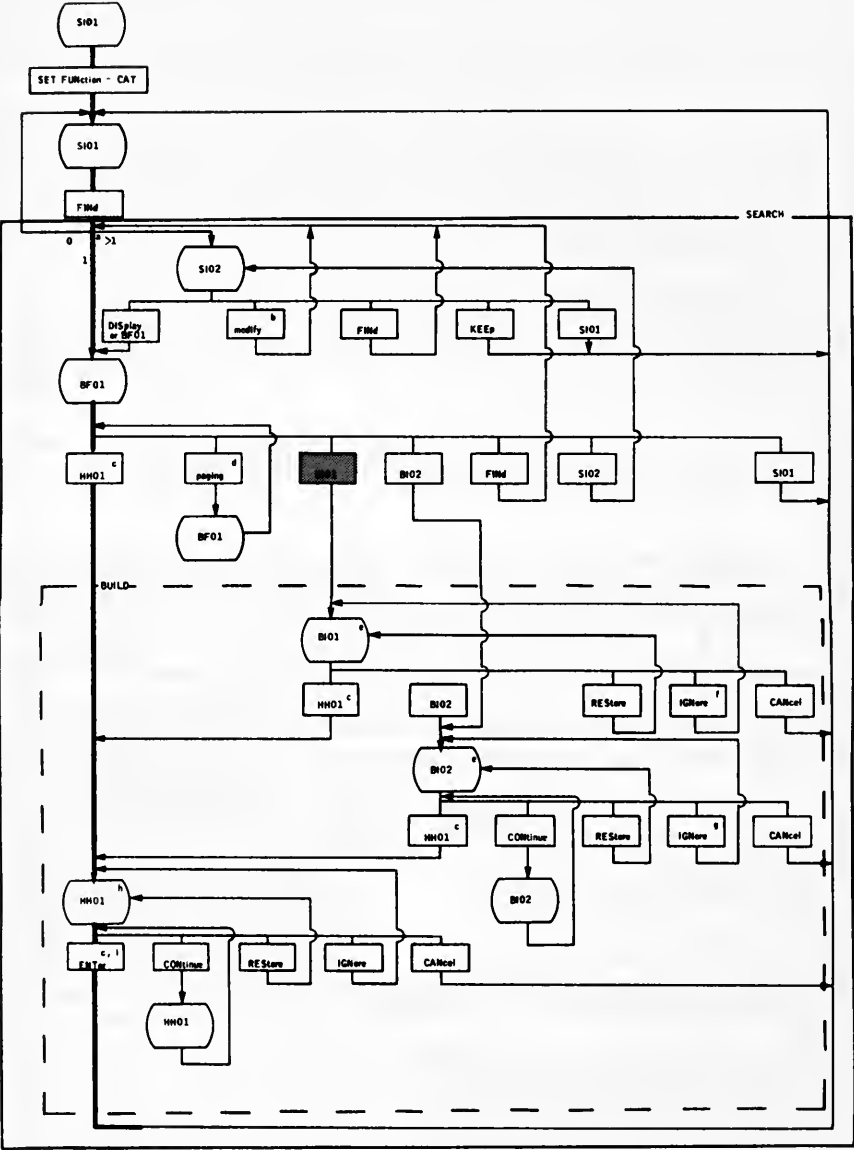


Fig. 14. Cataloging Function Protocols for the MARC Module

- <sup>a</sup> At this point, the results determine the directions taken. If search results are zero, the operator is again presented with the S101 screen. If one record is found, it is displayed on the BF01 screen. If two or more records are found, the operator is told so on the S102 screen.
- <sup>b</sup> The FIND command can be modified through the use of Boolean operators. At each stage in the search, an up-to-date form of the search request is displayed in the message field of the screen. The operator does not repeat or rephrase the request already issued, but adds modifying criteria to it.
- <sup>c</sup> The default command, prompted in the screen's command line.
- <sup>d</sup> The actual commands are "+B" and "-B" for paging from one record to another, and "+(P)" and "-(P)" for paging within a record.
- <sup>e</sup> Optional screens. If they are not used, data is taken directly from the MARC file (BMRC) to produce outputs.
- <sup>f</sup> Here, "IGNore" could also be "IGN/B102" or "IGN/HH01."
- <sup>g</sup> Here, "IGNore" could also be "IGN/HH02."
- <sup>h</sup> Mandatory screen.
- <sup>i</sup> Here, "ENTER" could also be
  - "ENT/FIN<search request>"
  - "ENT/S101"
  - "ENT/S102"
  - "ENT/BF01"
  - "ENT/DIS"
  - "ENT/SET"
  - "ENT/LOGOFF."

Fig. 14. Cataloging Function Protocols for the MARC Module (cont.)

```

SI01          BMRC-S          CATALOG          S          MDS
fin crd 72-140589

```

Fig. 15. Initial Search Input Screen

```

BF01          BMRC-S          72140589          CATALOG          S          MDS
fin crd 72-140589  RESULT:      1 BOOK(S)
HH01
White, Jon Ewhank Manchip, 1924-
  Cortes and the downfall of the Aztec Empire; a study in a conflict of
  cultures, by Jon Manchip White. New York, St. Martin's Press [1971]
  352 p. illus., maps, plans, ports. 25 cm. $10.00

  Bibliography: p. [335]-339.

  1. Mexico - History - Conquest, 1519-1540. 2. Cortes, Hernando, 1485-1547.
  I. TITLE.
  72-140589
  FI230.W46 1971  972/.02/0924
  CP:nyu  L:eng  REC:am  MS:N  ORD:10/13/72

```

Fig. 16. Cataloging Search Results

record. If the LC card number had been known at the time the book was ordered, it could have been used as a search term as well.

Fig. 16 shows the results of the cataloger's search. This is essentially the same screen that was displayed to the acquisition department operator when his search had been successfully completed (fig. 4), with the following differences. On the first line of the screen the system copied the function (CATALOG) and the operator's initials (MDS) from the previous SI01 screen. The second line, the message line, reports FIN CRD 72-140589 RESULT: 1 BOOK(S). The third line, the command line, displays the next command in the cataloging protocol, a request for the holdings (HH01) screen. The rest of the screen is the same as fig. 4 except for the last line, where the ordering date, recorded at the time of ordering, has been added.

Reviewing the book in hand and comparing it with the data displayed on the screen (fig. 16), the cataloger notices that the publisher and place of publication given in the book are different from the data found in the MARC file. The file data must therefore be corrected before catalog cards can be produced from it. Since the bibliographic data displayed in fig. 16 are protected and cannot be altered by the operator, an input screen must be used to change them. The operator accomplishes this by overriding the default command line (HH01) with the command BI01—a request for the bibliographic input screen. (The terminal operator is thus using one of the



HH01	BMRC-S	72140589	CATALOG	S	MDS
ME-	pn White, Jon Ewhank Manchip, 1924-				/
TSUT					/
TSSB	Cortes and the downfall of the Aztec empire;				/
TSRT	a study in a conflict of cultures,				/
ED	by Jon Manchip White.				/
PP	London, Hamish Hamilton				/
n	[1971]		L eng		CP nyu
PG	352 p.			/	
ILL	illus., maps, plans, ports.			/	
SZ	25 cm.			/	
LPR	\$10.00				REC am
TSTI	y, CRD<72-140589	/	NUC		MS N
SRN					
LC	F1230.W46 1971				
LCA					
DC	972/.02/0924				
SST	SCH				
AM-					
PUX					
RIP					

Fig. 17. Correcting a Record on the Bibliographic Input

HH01	BMRC-S	72140589	CATALOG	S	MDS
ENTER					/
LC	F1230.W46 1971				
LCA					
DC	972/.02/0924				
CAL	LC				
CT	y,	ETC LA, SC, L			CI <MDS>
SL	y,	FMI			
LOC	STK				/
BD	1				/
LOC	JAH				/
BD	2				/
LOC					/
BD					/
LOC					/
BD					/

Fig. 18. Default Holdings (HH01) Screen

SI01  
ENTRY PROCESSED

BMRG-S

CATALOG

S

MDS

Fig. 19. Holdings Screen Accepted, Return to Begin Search Screen

other options in the catalog protocol. This is shown in the shaded portion of fig. 14.) When the operator sends this screen to the computer (by depressing the SEND button on the keyboard), the system responds by displaying the modifiable bibliographic input screen. The operator then moves the cursor to the tenth line (PP) and types in the correct publishing information (fig. 17).

After this screen has been entered and has been accepted by the system, a default holdings screen would be displayed (fig. 18). The operator would enter the information shown in the shaded areas. The LC default data in the CAL field, if left unchanged by the cataloger, indicate that the cataloger accepts the LC call number. The entries after the ETC data element describe the additional copies of the catalog card requested—in this case, for the Latin American, Sacramento State Union, and New Acquisitions catalogs. The next two data elements input by the operator (LOC and BD) are the permanent shelving locations and the bibliographic descriptors (copy and volume) of the two copies. Here, copy one is located in the main stack and copy two is located in the Institute of American History Library.

When the holdings screen has been completed and sent to the computer, acceptance of it by the system (showing that the catalog build protocol—see fig. 14—is completed) is signified by the appearance of the search input (SI01) screen (fig. 19). The message line on the screen shows that the holdings entry was accepted by the system and the operator is free to go on to the next task. The SI01 screen is the default screen to begin any new operation.

Commands can be linked in order to reduce the number of screens required to process a book. For example, the operator can combine the ENTER command (to complete the cataloging process) with the FIND command (to search the file for the next book to be processed), keying both commands in the command line (line 3). If both the entry and the search are successful, a bibliographic display screen will appear for the next book, with ENTRY PROCESSED and the search command displayed in the message line (line 2).

As a result of the cataloging activity, a set of catalog cards and spine labels will be produced. The default option entered by the system in the CT (catalog cards) and SL (spine labels) data element fields in fig. 18 signified “yes” to the production of these items. This is done in an overnight batch operation. The computerized records for all of the catalog cards to be produced for each physical catalog will be collected and sorted in filing

sequence by the system before the cards are actually printed. Figs. 20 and 21 are samples of main entry and shelflist catalog cards. This completes the basic cycle of cataloging a book found in the MARC file.

## HARDWARE CONFIGURATION AND FILES

The BALLOTS CRT terminals are located in the Stanford Main Library in the acquisition and catalog departments (see fig. 22). These terminals are connected via twisted pair cables to a PDP-11 minicomputer in the Stanford Computation Center. The PDP-11 can handle approximately thirty to forty terminals. The PDP-11, in turn, is connected to an IBM 2701 parallel data adapter, which is connected to a selector channel on the Stanford Computation Center campus facility's IBM 360 Model 67 computer. The 360/67 runs the BALLOTS programs along with general timeshared and batch campus computing jobs. The high speed printer at the Computation Center is an IBM 1403, capable of printing 1,100 lines per minute. All regular and special forms for the library are printed on this high speed printer except for spine labels. The spine labels are printed on an IBM 2741 typewriter terminal with a modified platen. The spine labels are heat sensitive with a plastic covering to protect the printed information. The characters are printed using an Orator type ball, which was designed for IBM Selectric typewriters but can be used on the 2741 typewriter terminal.

The BALLOTS files were stored on CDC 23141 direct-access disk drives. Recently, the Stanford Computation Center (SCC) installed CDC 23142 double density direct-access disk drives to replace the 23141s. These provide twice as much storage on disk packs of the same physical size as those previously used. As a result, the BALLOTS file storage costs have been reduced.

## FULL SYSTEM DESCRIPTION

The full BALLOTS system is being implemented in a series of eleven modules (self-contained sets of services). Each module will add services to the library, including new forms, screens, and files. Everything described so far is contained in the first module, called BALLOTS-MARC. Fig. 23 illustrates the major features of each module.

The shaded portions of the figure are those aspects of the full system that are incorporated in the BALLOTS-MARC module. This first module handles the ordering and cataloging of titles found in the MARC file. The MARC file shown in fig. 23 is preceded by the number 1. This indicates that the MARC file is available in the first module. The output documents produced by the BALLOTS-MARC module are identified in the same way. These include purchase orders, catalog cards, spine labels, process slips, standing search


F1230.W46	Stack
white, Jon Ewbank Manchip, 1924- Cortes and the downfall of the Aztec Empire; a study in a conflict of cultures, by Jon Manchip white. London, Hamish Hamilton, 1971. 352p. illus., maps, plans, ports. 25cm.	
Bibliography: 335-339.	
1. Cortes, Hernando, 1485-1540. 2. Mexico - History - Conquest, 1519-1540. I. TITLE. LA SC L	
	
72-140589	

Fig. 20. Main Entry Catalog Card


F1230.W46	1971
IAH:	c.2
STK:	c.1
white, Jon Ewbank Manchip, 1924- Cortes and the downfall of the Aztec Empire; a study in a conflict of cultures, by Jon Manchip white. London, Hamish Hamilton, 1971. 352p. illus., maps, plans, ports. 25cm.	
Bibliography: 335-339.	
	
OSL	MDS
72-140589	

Fig. 21. Shelf List Catalog Card

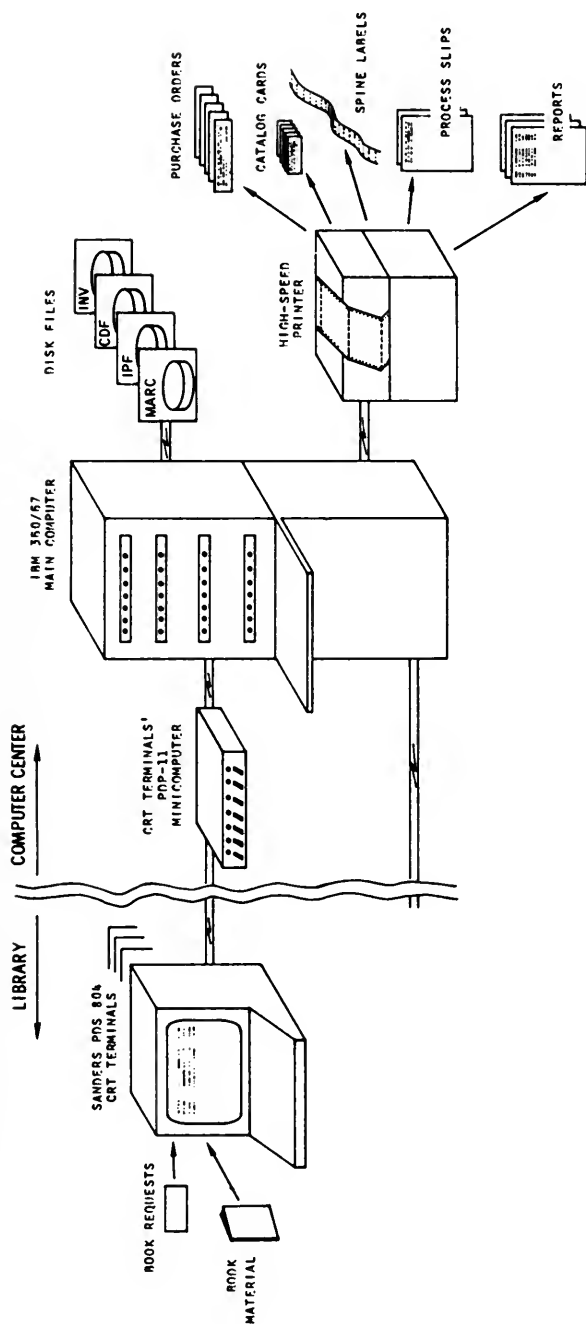
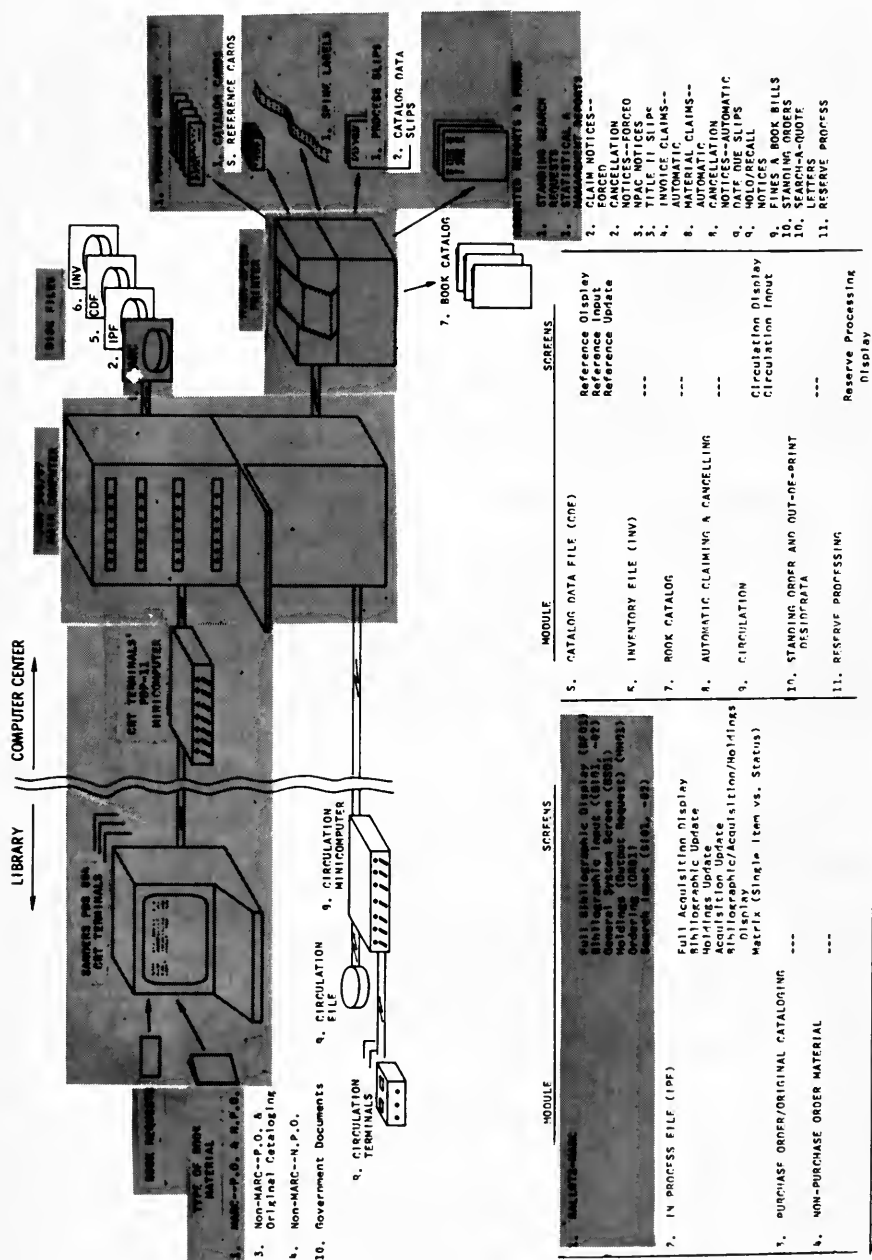


Fig. 22. BALLOTS Hardware Configuration



requests, and certain statistical and management reports.

The standing search request capability of the MARC module is a convenience to the library and performs a unique selective dissemination of information (SDI) function for a specific title. In a search of the MARC file, a title may not be found that the cataloger believes eventually will appear there (because it is a recent publication in English). In such a case, the cataloger can request that the system retain this search request and match it against all incoming MARC records during each weekly update. If a match is found, the cataloger will be notified on a special standing search request (SSR) notice.

The lower left-hand portion of fig. 23 itemizes the screens added to the system with each new module. The BALLOTS-MARC module uses the full bibliographic display screen (BF01), the bibliographic input screens (BI01, BI02), the general system screen (GS01—not described in this paper), the holdings screen (HH01), the ordering screen (OR01), and the search screens (SI01, SI02).

The eleven production modules that make up the full BALLOTS system are described below in the order in which they will be implemented.

1. **BALLOTS-MARC.** The library material processed by the MARC module is English-language monograph material appearing on weekly MARC tapes. (The restriction to English-language material is a consequence of the current scope of MARC; all roman alphabet languages are supported by this module.) The file in this module is an on-line MARC file of the most recent six to twelve months of MARC records. The file is essentially read-only, except for the addition of date codes for records processed by users. The actual size of the on-line file will depend on the requirements of the network libraries (see CLAN section below) balanced against file storage costs. Purchase orders, process forms for technical processing files, catalog card sets, and the spine labels are produced on request for any titles in the MARC file. Automatic weekly searches to match user requests with new additions to the file are available through the standing search feature. In this first module no permanent on-line records are maintained during technical processing other than the full MARC record, although a tape copy of the records for each book cataloged is retained for later use. Such on-line record keeping will appear in modules 2, 5, and 6. This module processes approximately 35 percent of Stanford's acquisitions and 26 percent of its cataloging. The percentage of support to network library processing (again, see CLAN section below) is slightly larger than the Stanford figures in this and later modules.
2. **MARC-IPF (MARC In-Process File).** This module adds an in-process file and additional printed outputs such as claim and cancellation notices, when requested by library staff. Only MARC material is handled; when a record is found in MARC it is transferred to the IPF and is retained there as an updatable record throughout technical processing. Since the record

will not be purged from the IPF until modules 5 and 6 have been implemented, the file will represent all titles ordered and cataloged by the library using the automated system. A record in MARC-IPF can be used again if additional copies of a book are ordered.

3. **Purchase Order/Original Cataloging.** No new file is added with this module, but the use of the IPF file is expanded considerably with the addition of new bibliographic records input entirely at the terminals. Acquisition and cataloging (NPAC—National Program for Acquisition and Cataloging) notices can be produced. The scope of the material for which a record is created is expanded. It adds all non-MARC roman alphabet material that requires a purchase order in ordering, and any material that requires original cataloging. Thus, if a record is not found in the MARC file, a new IPF record is created using the terminal. This module will process an additional 52 percent of acquisitions and 42 percent of cataloging. Thus services at this point will cover 87 percent of acquisitions and 68 percent of cataloging.
4. **Non-purchase Order Material.** The scope of material added to the IPF is expanded to include non-purchase order material receipt—gift, exchange, approval, and blanket orders. In addition, an invoice-claiming feature is included to inform the acquisition department of material for which no invoice has been received within thirty days. This module will process an additional 7 percent of acquisitions and 6 percent of cataloging. Modules 1 through 4 will process a total of 94 percent of acquisitions and 74 percent of cataloging.
5. **Catalog Data File (CDF).** This module involves building the on-line catalog data file. Since the implementation of module 1, *BALLOTS* will have saved bibliographic information, and this data will be used to create the CDF. From this point on, all catalog records will enter the CDF after the record for a given title is no longer required in the IPF. As the CDF grows, it will become an increasingly valuable reference tool for acquisition, cataloging, and patrons' use.

When the Catalog Data File module has been implemented, it will be possible for any searcher in the library to search the catalog data file (CDF) for recent acquisitions shelved and in circulation, to search the in-process file (IPF) for new titles on order but not yet cataloged and shelved, and to search the MARC file for recent Library of Congress catalog records—in a single search request. As new acquisitions are added to the collection, the catalog data file will become an extremely effective reference tool. After two or three years of use, the catalog data file should reflect all recent acquisitions. Any new publication should be in the catalog data file if the book is shelved, or in the in-process file if it is on order. This eliminates a considerable amount of manual searching.

6. **Inventory File.** Machine-readable bibliographic and holdings records



already exist for all 60,000 titles now in Stanford's Meyer Undergraduate Library. In this module, these records will be converted to **BALLOTS** format and used to build an on-line Meyer inventory file (INV). At this point, Meyer cataloging processing will work directly with the on-line file. This file will be used later on for reference and for the patrons' access to the complete holdings of the undergraduate library. Other libraries with the entire collection in machine-readable form can be handled in a similar manner.

7. **Book Catalog.** This module can be used to create any book catalog done in the Stanford format. At Stanford it will allow the Meyer book catalog to be produced directly from the INV file without going through the punched card process presently used.
8. **Automatic Claiming and Cancelling.** This module adds programs to review IPF records automatically, to determine if ordered material is overdue. Material may be claimed several times and finally cancelled if the dealer does not respond. The acquisition department may override a scheduled claim or a cancellation.
9. **Circulation.** This module is designed to handle the complexities of the research library circulation system. Using data from the inventory file, a Meyer Library self-service circulation system will be implemented first, including charging, discharging, initial check-in, circulation searching, recall, holds, overdue processing, fine handling, and fine payments.
10. **Standing Order and Out-of-Print Desiderata.** The capability of establishing standing orders (SO) and receiving the nonserial materials arriving with SOs will be added with this module. In addition, out-of-print items (OP) will be added to the IPF and search and quote letters produced for OP dealers. If an OP item can be procured, it can be ordered using the record already in the IPF.
11. **Reserve Processing.** This module adds reserve book ordering and processing for users. It will be added to the services offered to Meyer staff through the use of the INV and IPF.

The **BALLOTS** system design includes several features unique among the major on-line library automation systems using CRT terminals (such as the Ohio College Library Center—OCLC—and the Experimental Library Management System—ELMS—of IBM). The most notable of these are the programmable CRT terminal that aids the user in input and display; the protocol structure and the command language associated with it; the standard screen format; the fact that an entire screen is entered and processed at one time, rather than just one data element; and the flexible interactive searching capability. The method of searching used in **BALLOTS** was developed by a sister project, **SPIRES** (Stanford Public Information Retrieval System), whose connection with **BALLOTS** is outlined in the reports listed under "Selected References."

## CLAN (CALIFORNIA LIBRARY AUTOMATION NETWORK)

The features of the BALLOTS system have been kept as generalized as possible, so that the system could be adopted for use in other libraries. At the present time, the staffs of two autonomous libraries at Stanford (The Law Library and Lane Medical Library) and of five libraries in the San Francisco Bay area are preparing for the implementation of parts of the BALLOTS system in their libraries. These libraries have been reviewing the BALLOTS specifications in order to note any changes or additions they require. To date, the number of these changes seems to be very small, and they do not represent any substantial modification of the BALLOTS system. Assuming adequate funding, the plan for network implementation is as follows.

For the first four to eight months after a module has been implemented and placed in operation at Stanford, it will be closely observed and monitored. During this period, the network version of the module will be checked out and tested for network use, and the network libraries will install equipment and conduct training classes and acceptance tests. When all this is completed, the module will be put into network pilot operation. Thus, the module will undergo four to eight months of heavy use in its original version prior to its network installation. This will reduce implementation time and effort for the network users.

The BALLOTS system is intended to provide a library tool operating in the library's daily production environment. The system was designed with the help of the library, and will be used by the library staff. No special terminal operators will be hired. Throughout the designing of the system, continual efforts were made to create a system as convenient and useful as possible to the library staff. At a number of points in the system, smoothing the way for the user has meant increasing the complexity of the BALLOTS analysts' and programmers' tasks. This paper has made no attempt to describe the programmed structure underlying BALLOTS operations. Rather, it gives an overview of these operations as they are seen and participated in by the librarian or technical processing assistant.

### Selected References

The following publications describe the initial planning and designing of BALLOTS, the development of the proposed network, and the evolution of the system from 1967 to 1971.

Epstein, A.H., *et al.* "An On-Line Network—Cooperative Planning with Several Libraries." In Jeanne B. North, ed. *ASIS: Proceedings of the American Society for Information Science*. Vol. 8. Westport, Conn., Greenwood Publishing Co., 1971, pp. 227-31.

———. *Final Report, Project No. 7-1145, Grant No. OEG-1-7-071145-4428, Bibliographic Automation of Large Library Operations using a Time-sharing System: Phase I*. Stanford, Calif., Stanford University Libraries, 1971.

- \_\_\_\_\_. *Final Report, Project No. 7-1145, Grant No. OEG-0-70-2262, Bibliographic Automation of Large Library Operations using a Time-sharing System: Phase II, Part 1.* Stanford, Calif., Stanford University Libraries, 1972.
- Montague, Eleanor. *Summary of a Feasibility Study on the Participation of Four Colleges and Universities in a Stanford University Library Automation Network.* Stanford, Calif., SPIRES/BALLOTS Documentation Office, 1971.
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Hofstra University  
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## Automation, or Russian Roulette?

I feel somewhat like Daniel must have felt in the lions' den, and if I respond in something like an ominous roar, let me make clear that I address myself primarily to card-carrying, dogmatically convinced computerators who have wrapped themselves in the security blanket of the computer, and do not dare to think about the basic problem that it presents to librarianship. If this kind of computerator gets mad at some of the things I say, it is because his ego is involved in the computer, the worst form of slavery for man; if he does not, it indicates he is still capable of independent thought about the basic problems, and there is some hope.

When I was first invited to speak at this clinic because my point of view was "controversial," I thought that, despite the cliché, this would open discussion on the merits of computerizing library operations. After seeing the preliminary program, it was clear there would be no discussion. Rather, I was to be the clinic's token Black. This impression of rank discrimination is reinforced by the fact that I am the last of nine speakers, a kind of soft-shoe shuffle act after the play is over to ease the stir of the audience as it begins to depart.

We Blacks realize what a powerful "establishment" computerators are. One reply to my May 1971 *College & Research Libraries* article<sup>1</sup> pointed out that the public relations apparatus of computerators is second only to that of the Pentagon. And on the whole, library computerization still wears a jaunty mantle, like that of Superman, which cloaks it from rules that govern every other aspect of librarianship. But it is no longer new, and the cloak is wearing threadbare. Ellipses of fat are seen jouncing through the shredded cloth. As Tennyson once said, "The old order changeth, yielding place to new," and the endless hoard of gold flowing from the cornucopia has dwindled to a trickle of sand. We are all bankrupt.

Let me therefore touch lightly on the financial conditions of some of the universities whose prime public relations pieces have been polished up for exhibition during this clinic.

Two years ago, when I viewed the new Northwestern University Library, I learned from the director that his book budget for the center campus library, where the bulk of demands from a very broad, richly developed program of graduate studies is registered, was less than ours at Hofstra, which is still emerging and has small commitments to a graduate program. When I visited the University of California at Los Angeles Library in 1970, there was severe understaffing in its branch libraries, and its lack of funds for collection development has now become notorious in the profession. In the last two years it has cut its faculty by 200 positions. Stanford University had discontinued significant academic programs, and its president is among the most honest in his forthright declaration that they are unable to afford what they are now doing, despite a mountainous endowment. What university is not in a condition of financial restriction? Yet for the past two days we have been hearing of on-line systems, the most expensive condition of computerization. Under these financial conditions, which are not temporary, how long can we go on spending money for playthings? In my estimation, library computerization has about three years left, during which either joint-sharing or mini-computers will prove beyond a doubt the economic necessity of the computer, or it will go.

When speaking to theologians, one should speak from Holy Script. I, therefore, take as my text Forrester's Law, which states that in complicated situations, efforts to improve things often tend to make them worse, sometimes much worse, and on occasion calamitous. According to Forrester, in complicated situations the obvious thing to do is often dead wrong. With the slides greased in advance by Vannevar Bush and Buckminster Fuller, and oiled by John Kemeny of Dartmouth, librarians slipped into the assumption that the obvious answer to the complexities of radically expanding libraries was computerization of operations. This assumption is dead wrong in general, and I have been exploring for some time to determine whether it is wrong in every particular as well, with no clear indication as yet that it is not. This, briefly, is my central text. I will attempt to bring computerators to realize the depth of their sins, and to lead them to a glimpse of a better world, where the reward is honest living.

Perhaps I should begin with the basic heresy, which I did not invent but did reassert in my earlier article,<sup>1</sup> that the computer poses a managerial problem no different than any other aspect of the library, whether staff, materials or other machines. One must think about the reasons for using it and justify its costs. The responses to that article were varied. One group wanted me to launch a Moslem holy war, a Jiddah, against the Christian dogs. Four computer specialists, two teaching in graduate library school and two in

charge of library computer operations of some consequence agreed that the whole field was a farce, and ought to be wiped out.

Within a month of my article, Daniel Melcher's article appeared in *American Libraries*,<sup>2</sup> stating essentially the same things about library computerization, although we had never met or corresponded. When I wrote to him objecting that his optimistic conclusions about the future of computers in libraries were not justified by either his view or the substance of his article, he replied that I had misread him, that he did not really believe that computers would ultimately be economically justified in libraries. Since Melcher had applied the computer extensively in his own publishing operations, he cannot be viewed as lacking in practical knowledge.

There followed an ad hoc evening session of LARC at the Dallas ALA meeting chaired by William Axford, with Allen Veaner as speaker discussing my article,<sup>1</sup> and with much audience participation. This resulted in a pamphlet by Veaner published by LARC.<sup>3</sup> Veaner gave a good, reasonable discussion of my paper. However, only a few asked themselves the question, "Is Mason really talking about me?" Everyone seems to have assumed that my article referred to computer projects other than theirs.

There have emerged since then, in letters and in print, some sharp differences among library computerators about some very basic issues, with eminent practitioners standing firmly on both sides. Is it possible to control with any degree of sensitivity the quality of programming in a system? I am told by one eminent computerator in Los Angeles that it is not possible, and by another in New York that it is. Is it possible to transfer generally systems of programs from one computer to another? I am informed from Arizona that it is done all the time, and from California that it is possible under rare, optimal conditions to transfer limited programs, but that the chances of transferring a system without accepting totally the same computer machinery are virtually nil. I can add from recent experience on the Hofstra campus that transferring a series of comparatively simple housekeeping programs from an IBM 1130 to a Spectra 7046 has been agonizing, and for a large number of programs impossible, with much reprogramming necessary.

Does multiplying computerized operations by stringing them together in a system make them economical? From California, I hear claims that the systems approach automatically makes everything economical, from Massachusetts, that there is no evidence it does. Is it economical to computerize circulation? From many places I am told this is one of the best operations in which to achieve economy; from New York, the word comes that no one can beat eight to ten cents a manual circulation with computers. And so it goes, vocal opinions on both sides about the economical feasibility of computerizing acquisitions, serials, etc. From these contrapuntal choruses of computer experts I conclude that the field does not really know what it can do successfully, and in what terms, and for what aims. In a very real sense, the

entire field of library computerization is a floating world. This condition by no means warrants the divine conviction that descends, like the Holy Dove, on librarians who computerize operations.

This floating-world mentality is apparent in many responses to my article.<sup>1</sup> While my central point was that the computer could not be justified on the grounds of cost, answers like the following were forthcoming: "It's successful." Whether successful in operational, public relations, or economic terms is not mentioned. This is the kind of floating nonthought that angers me because it indicates a total disregard of aims and economics. "Undergraduates like it." Undergraduates like sex, too; are we therefore to provide it in libraries? "Everyone is pleased with it." This makes it sound like a rose garden, emphasizing the charm of the computer. In his Dallas speech, Allen Veaner states the following:

There are numerous successful applications that he [Mason] failed to mention or ignored completely. The Ohio College Library Center has a very successful card production system based on MARC tapes. Another, is the New York Times Information Bank that is about to become operational. There is the Ohio State University circulation and book information systems that represent a notable extension to traditional library services, and would not have been possible without the computer. What about Northwestern University's self-service book charging system? The Harvard University circulation system and the Harvard shelflist conversion project have been in progress for many years, as has the University of California Union Catalog Supplement project.<sup>4</sup>

Now, my central argument was that the computer costs too much, but Veaner does not even mention costs. The Ohio College Library Center at that time was still in a batch system of card production that was 50 percent more expensive than reasonably good MT/ST card production. The New York Times Information Bank was not running in June 1971, is not running yet in April 1972 (after an expenditure of from three to four million dollars), and according to recent reports there is no certainty that it ever will run successfully in the terms it was originally conceived, and almost certainly will not be economically justifiable.<sup>5</sup> (Note that Veaner, a highly intelligent man, scolds me for ignoring a successful computer application that does not even exist. This is the kind of dislocation of brains that occurs among computerators. It must have something to do with machine vibrations.)

Ohio State University Library's circulation system interests me very much, but Veaner does not mention its staggering development costs or its operational costs of approximately \$300,000 a year. Northwestern University's charging system is a prime example of an operation that was computerized as a public relations piece, and the 50-page report of this system<sup>6</sup> makes no mention of costs other than the costs of punching book cards. Is this not fraud, that a totally detailed analytical account of a library operation makes no mention of operational costs? If we are to defend Harvard's and Cali-

fornia's systems on the grounds that they "have been in progress for many years," and with no reference to costs, then most library operations can be defended on exactly the grounds on which computerators have attacked them.

What Veaner means by calling these operations successful is that they are running, and I return once more to my basic point: when you are running you are in a race, you are competing. The question is: What can these computerized operations compete with, and in what terms? It is precisely to this question that I am urging the entire field of library computerization. But, as I have tried to indicate, one of the characteristics of this field is a highly visible floating mentality that refuses to ask precise questions in a detailed manner about the aims and intentions of computerization—about why it is being done at all.

This mentality has been encouraged by an elaborate smoke screen that has sheltered the entire field from the probes of reality. From the beginning, and as late as Henriette Avram's speech with me to the New York Technical Services Librarians in November 1971,<sup>7</sup> it has demanded "a privileged sanctuary not accessible to any other library operation, freedom from cost challenge."<sup>8</sup>

The first component in this smoke screen was the assumption that librarianship was behind the times, that the times were represented by industry, and that industry should be copied. To one who grew up during the Depression amidst stark evidence that industry did not know what it was doing, the notion that all is right with the industrial world is curiously perverse. Be that as it may, the argument proceeded on economic grounds, replete with graphs and diagrams, to indicate that operating expenditures in academic libraries were increasing so fast that they were likely to ruin the entire economy. Fig. 1 is a graph from a report by Mathematica entitled *On the Economics of Library Operations*, submitted to the National Advisory Commission on Libraries in 1967. The Wholesale Price Index, the cost of goods produced in our economy, is fairly stable from 1951-1966. Included is a comparison of the increase in the amount spent for library salaries per student enrolled (~~oooo~~), and the amount spent for library materials per student enrolled (~~xxx~~). These comparisons are made on the assumption that universities are factories producing students as commodities. If this assumption is accepted, then it follows that the costs of library salaries and library books have increased faster for each unit of commodity manufactured by universities, than have the costs of commodities in the economy as a whole. But this is both ignorant and ridiculous!

First of all, it assumes that the books bought each year and the staff services each year serve only the students enrolled during that year. Some of libraries' services such as circulation, are indeed consumed on the spot, but the books remain, and all the services that shape finding tools and the location of books in the collection are permanent additions. A large part of these costs is capital investment, not operating costs.



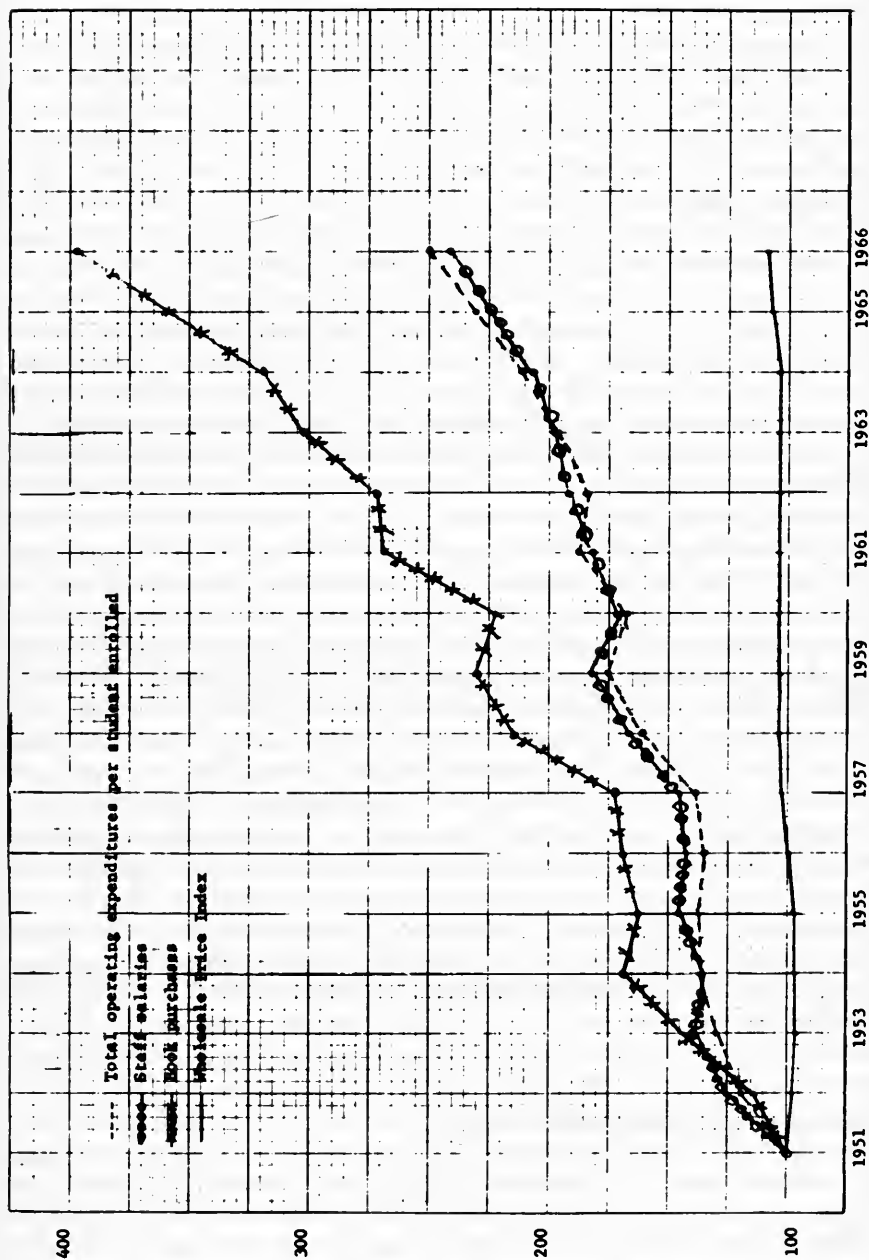


Fig. 1. Operating Expenditures per Student Enrolled for Libraries of Institutions of Higher Education vs. Wholesale Price Index (1950-51=100)

Beyond this ignorance lies the basic fallacy of comparing the cost of commodities with the costs of operating a library, which is basically a service industry. There is little comprehensive information about trends in the costs of services in our economy, but we do know that each year a larger and larger proportion of the gross national product goes into services and that their costs are escalating rapidly. If the graph in fig.1 had compared the costs of instructional salaries and equipment per student enrolled, it would undoubtedly have shown that they had gone up even faster than library costs; both together would have indicated what we all know—that a greater portion of the gross national product went into higher education after 1951 than ever before. The sharpest increases in staff salaries and book purchases per student begin in 1960, a short time after Sputnik, when the American public decided that education was the answer to everything. To compare the costs of producing commodities with the costs of services tells absolutely nothing about either of them.

Nevertheless, continuing along the lines of pseudo-economics, a group of librarians proceeded to argue that libraries must come into line with industry, that industrial productivity increases about 3 percent a year, while library productivity remains relatively the same. Industrial productivity increases, the argument goes, by application of machinery—especially the computer. The computer must therefore be applied to the library to bring its costs in line with those of the overall economy.

Once again we are comparing the production of commodities with a service industry, but this time we are on unfirm factual grounds. Unfortunately, the figures on which our analysts have leaned so heavily (Kilgour revived this red herring in *American Libraries* for February 1972)<sup>9</sup> end with 1966. In the meantime, we have learned things about our economy. Since 1967, and at a time when industry has been technologized as never before, and when perhaps 80,000 computers were being used in industry, the increase in productivity ground nearly to a halt. In 1969, which was a boom year, and 1970, productivity in output per man hour increased less the 1 percent each year.<sup>10</sup>

This fact has been pointed up sharply by Kenneth Boulding, a high ranking economist, in a speech delivered at Wright State University, in January 1972. He pointed out that while productivity in our economy has been increasing 2 to 4 percent a year for the past century, it has hardly increased at all in recent years. He concluded, "Automation seems to be a total fraud. There is not the slightest evidence of greatly increasing productivity in manufacturing processes."<sup>11</sup>

The absence of a surge in productivity as we increased the use of computers in industry over the past twenty-five years does not seem to support claims for the machine by library computerators. Skepticism about computerization is not confined to me and Kenneth Boulding. Last August,

the annual conference of the Association for Computing Machinery, meeting on the twenty-fifth anniversary of the invention of the electronic computer, was a highly critical, self-lacerating session. A significant paper by Harvey Golub, a principal in McKinsey & Company, an important New York computer consulting firm, described the life cycle of a systems development project as follows: Phase I—Wild enthusiasm, Phase II—Disillusionment, Phase III—Total confusion, Phase IV—Search for the guilty, Phase V—Punishment of the innocents, and Phase VI—Promotion of nonparticipants.<sup>12</sup>

Beyond this note of humor, Golub cited a survey he had recently made of 100 companies in eleven industry groups, which showed conclusively that investment in computers did not give a company any significant competitive advantage. In fact, four of the industry groups "exhibited essentially a negative correlation between investment in computers and results."<sup>13</sup> That is, the more the investment in computers, the less the results. He concludes, "The companies that do well today are not those with lots of computers but rather those with able management in depth."<sup>14</sup> This may account for a recent report of a large library with a computerized circulation system that takes a week to reshelve books after they are discharged.

These views from nonlibrarians do not support the view that application of the computer to library operations will automatically increase productivity; indeed, if it costs more to do essentially the same things, productivity will decrease. I think that the get-with-industry smoke screen has by now been demolished.

Two other reasons advanced by computerators for absolving themselves of cost accountability were that collection growth was escalating at an angle of 85 degrees, and that there was a severe shortage of librarians. With the onset of a realistic economy in the academic world, and radical cuts in book budgets during the past two years which will continue, if not increase, in the future, we find that the escalation curve in processing has leveled off or declined. At the present time, the demand for library school graduates precariously meets the supply. In 1973 there will be a surplus of graduates.

I will devote the rest of my talk to the cost of both conventional operations and computer operations. It is clear to me that librarians will have to defend every nickle they spend in terms of effectiveness in the very near future, or have it taken away from them. So let us see what cost problems are, and how to go about establishing whether or not it is justifiable to apply the computer to any library operation.

There are four basic problems related to costs in computerizing library operations: (1) the open-ended cost of development, with no ceiling on costs at all; (2) the unpredictability of operational costs after the system is developed and stabilized; (3) the lack of easily available information on costs of competitive manual or manual-machine methods (i.e., what is a reasonable circulation unit cost) to tell us whether what is being done by computer is

extravagant or economical; and (4) the unwillingness of computerators to approach the real complexities of determining the cost of their operations, and set cost components in a list of priorities by their impact on unit costs.

The first problem has long ago been met by industry, which was so badly burned in converting to second generation computers to the extent that it has held off applying third generation computers because of programming costs.<sup>15</sup> In librarianship, it is clear that the do-it-yourself phase is over. No one can really afford a programming staff, and the future will depend on the feasibility of large group combination efforts, or easy transferability of programs, with local adjustments made by the central university computer staff, or a single mop-up programmer. The other alternative is one which libraries should have insisted on from the beginning—that the computer industry take the library's specifications and bring back a program ready to do exactly what is wanted done, debugged, at a reasonable cost. This is likely to happen, since no longer can a slick IBM salesman charm his bug-eyed, ignorant client into believing that all he has to do is buy a 360/91 and gold will start showering down on him in savings.

For the second problem, the unpredictability of operation costs, industry is turning to outside service companies which either run the house computer on the property, or perform the operations on an outside machine. In either case, specified services are contracted at a known price, and can be dropped if they prove unsatisfactory. As one executive said, "I would like someone to take the cow away and start delivering the milk."<sup>16</sup> The closest librarianship has come to this is with card production services, and I have seen none that can begin to compete with conventional production costs.

The third problem is not as difficult as it seems, since good cost analyses of "conventional" operations are being done all around the country. The task of gathering and assembling them into a manual should be undertaken. All that is needed is one thorough, reasonable cost analysis of a well-run manual circulation operation to establish a target cost for comparison, and the figures for such an analysis do exist, although they are diffused.

In the fourth problem, computerators are hesitating because they insist on the possibility of a perfect cost accounting before they will try any. That is, if it is not possible to determine to the fraction of a cent the assignable costs to one operation of a systems group that is doing three things at once, they do nothing. This feeling is unreasonable, since it is easy to obtain valid estimates for purposes of comparison, which is the main purpose of costing at this point in history.

The other difficulty is that few computerators understand what a valid cost analysis is. During the past year, I have searched in vain for a thorough, honest, reasonable and accurate cost analysis of any computerized library operation. I had been told that a number existed, but upon investigation I found there were really no cost figures available at all.

About a month ago, a professor of library computerization in a graduate library school, with whom I have had a good-natured running dispute about these matters for a long time, wrote me that a noted recently computerized circulation system in an eastern state had figures that "beyond a shadow of a doubt show money saved."<sup>17</sup> I wrote for the figures, and had a call from the head systems analyst who informed me that he did not have any figures that proved beyond a doubt anything. The only figures he had were for consumables, and for machine run-time—no figures for systems salaries, no figures for desk costs. That is to say, he did not even have a general idea of what his unit circulation costs or total costs were. Yet this system is in the process of being adopted intact by ten or more other universities who have no idea what it is going to cost.

If you hired a librarian without setting his or her salary; if you bought a collection of books without setting a price and asked the seller just to send you a bill, denomination unknown, you would be fired on the spot. But you can install a computerized circulation system under the same irrational conditions and get a hero's medal. Is this librarianship?

There are three important reasons why careful cost control of everything in libraries is needed at this time: (1) to be able to defend and maintain, in a fiscal squeeze, those things that we most want; (2) to know what effects budget cuts will have; and (3) to evaluate new changes as they come along.

Let me tell you what I have been sent as cost analyses for computerized operations. The first group is from one of the most highly regarded library computerized operations, a system which has been adopted by all libraries in its state university system, and transferred to three other university libraries. Figs. 2 and 3 comprise the cost analysis sent by its originator to convince me of its cost effectiveness. The figures (fig. 2) for the circulation system indicate numbers of transactions, machine run-time, and the machines required. The figures for acquisitions (fig. 3) show the number of transactions, machine run-time, machines used, and machine language used. Fig. 4 shows total machine run-time for the two systems above plus a documents processing system, and details of development times. In addition, there is a paragraph in an accompanying letter about computer machine costs (fig. 5).

I find it appalling that this is all the information I was given. These machine times are interesting, but one can tell nothing about total costs of the operation from them. There is no list of what steps in any operation are performed, and therefore we cannot tell what collateral steps are performed manually to complete the system. There are no systems salary costs. There are no costs of collecting and preparing data for the computer. We do not know what happens after the computer prepares its reports. In fact, this is no more than 10 percent of the information needed to judge whether the system is cost effective. This is not a cost analysis by any means, yet one of librarianship's outstanding computerators considers it convincing.

### **████ CIRCULATION SYSTEM**

#### Loads

Period 7-1-68 to 6-30-69

1. Transactions 80,000
2. Computer Hours (clock)\* 125
  - IBM 360 E40
  - System 2-2415 (M2 15KB)
  - Hardware 1-1403 (600 Lines/minute)
  - 1-2540
  - 1-2311
3. Approximate processing time per transaction .1 minute = 6 sec.
4. CPU Hours = about .4 clock hours (or less) for this system.  
CPU Hours = 50

\* Includes all support processing and special runs.

Fig. 2. Proof of Cost Effectiveness—Circulation System

### **████ - LIBRARY ACQUISITIONS INFORMATION SYSTEM**

#### System Hardware Requirements

CPU	System 360 with 32k bytes core. Model 25 or larger.
TAPES	Two drives. Any Model.
DISK	Total 7.25 Million bytes maximum, all work files.
PRINTER	Any Model. 1403 best.
CARD READER	Any Model. 2540 best.

#### System Software

99% Cobol "F", 1% 360 Assembler

#### System Loads (Computer Usage)

Period 7-1-68 to 6-30-69

1. Transactions (new titles) 40,000
2. Computer Hours (clock) 50.5
  - Using: IBM 360 E40
  - 2-2415 M2
  - 1-1403 (600 L/M)
  - 1-2540
  - 1-2311
3. Approximate processing time per title .075 minute
4. CPU Hours = about .4 clock hours

Fig. 3. Proof of Cost Effectiveness—Acquisition System

ANALYSIS OF COMPUTER USAGE BY LIBRARY SYSTEMS  
AT ██████████ UNIVERSITY

Period Covered 7-1-68 thru 6-30-69

Hours used (clock)	Production	Testing	Total
Library Circulation	111	10	121
Library Acquisitions	50.5	10	60.5
████████ Documents	20	9	<u>29</u>
			210.5

ANALYSIS OF DEVELOPMENT OF SYSTEMS FOR THE  
██████████ UNIVERSITY LIBRARY

This analysis covers the following three systems presently in use at  
██████████ in the library.

1. Library Circulation
2. Acquisitions
3. ██████████ State Document Processing

System No.	1	2	3
A. Starting Development Date	1-1967	1-1968	1-1969
B. Number of Man Hours in Development	720	500	400
C. Number of Programs	17	25	15
D. Implementation Date	9-1967	7-1968	6-1969
E. Support Hours/Month	10	30	30
F. Total Hours Devoted (Development and Support) Since Development Date	1360	1400	700

Fig. 4. Proof of Cost Effectiveness—Machine Run-Time

Several points need to be noted in interpreting the above data.

(1) The hourly rate charged for the system hardware at the time was \$80.00 for a commercial user and \$40.00 for an internal department. The equipment was as follows:

IBM 360-E40  
two 2415 (M2 15 KB tape drives)  
one 1403 Printer (600 lines a minute)  
one 2540 Card Reader  
one 2311

At the institutional rate of \$40.00 an hour, our computer charges for the year's operation (210.5 clock hours) was \$8420, or \$16,820 if you use the commercial rate. To this has to be added \$3084 per year for the IBM 357 data gathering device for the circulation system and \$2016 per year for three IBM 026 key punch machines which supported all three systems.

Fig. 5. Description of Machine Costs

The next figure (fig. 6) is an analysis of the costs of a midwestern computerized circulation system. This is a detailed summary of costs by their larger components, which contrasts unit costs of the manual system in the first column with unit costs of the computerized system which replaced it. Note that three disastrous years followed the manual system's removal because of faulty programming. If we assume an annual increase of 5 percent in the manual cost, which is more than it would have been during the three years 1967/68 through 1969/70, the computerized system cost the library \$115,000 more than the manual system would have cost. This should have cost someone his head.

In 1970/71 they reprogrammed and cut unit costs, and the economies seem to be increasing in 1971/72 to a unit cost of \$0.38 compared to a manual cost of \$0.37 five years previously, which surely would have been more than \$0.38 by now. This seems to be worthwhile until compared with a manual system (fig. 7). Fig. 6 showed costs for charge-out, discharge, and related functions. Fig. 7 shows the total cost of circulation in another library from charge-out to shelf return, including all costs of stack maintenance, and certain other activities centered in the circulation department. The total cost is nearly \$0.10 below the previous out-and-in circulation costs, which in the system represented in fig. 7 are probably less than \$0.15. This is not a very efficient manual system; it is my own, and we are revising all aspects of it this year. What does the computerized circulation system provide that the manual system does not? Nothing for which there is a demonstrable need.



COST ANALYSIS OF THE CIRCULATION SYSTEM  
 JULY 1, 1966 TO DECEMBER 31, 1972

Totally  
re-programmed  
1970/71

fiscal year	1966-1967			1967-1968			1968-1969			1969-1970			1970-1971			1971-1972		
	GE 635	other	IBM 357	GE 635	other	IBM 357	GE 635	other	IBM 357	GE 635	other	IBM 357	GE 635	other	IBM 357	HW 635	Other	IBM 357
month																		
July	-	-	-	\$1,157	\$4,33	\$750	\$1,537	-	\$767	\$1,520	-	\$767	\$1,723	\$674	\$699	\$1,286	-	\$713
August	-	-	-	2,183	-	750	1,730	\$132	767	1,185	\$156	767	1,786	-	699	1,790	-	713
September	-	-	-	2,769	-	750	1,020	132	767	2,045	-	767	1,517	-	699	1,361	-	713
October	-	-	-	4,390	-	750	1,261	151	767	1,912	161	767	1,572	-	699	1,426	-	713
November	-	-	-	3,240	322	750	3,248	124	767	1,762	31	767	2,202	-	699	2,022	-	713
December	-	-	-	2,604	-	750	2,065	217	767	1,758	-	767	1,737	-	699	2,046	\$100	713
January	-	-	-	2,263	190	750	3,516	-	767	3,166	450	767	1,604	-	699	-	-	-
February	-	-	-	1,817	-	750	4,308	463	767	3,989	2	767	1,601	-	699	-	-	-
March	-	-	-	1,835	819	750	5,130	-	767	3,982	-	767	2,049	111	699	-	-	-
April	-	-	-	2,687	503	750	3,051	7	767	2,932	-	767	1,421	-	699	-	-	-
May	-	-	-	1,992	322	750	4,723	255	767	2,797	-	767	1,447	-	699	-	-	-
June	-	-	-	1,518	20	750	2,555	-	767	2,863	27	778	2,035	-	706	-	-	-
Sub-total	-	-	-	\$28,455	\$1,312	\$9,000	\$34,450	\$1,481	\$9,195	\$30,011	\$327	\$9,213	\$20,744	\$785	\$8395	\$9,931	\$400	\$4,458
Total	-	-	-	\$10,767	-	-	\$15,126	-	-	\$10,054	-	-	\$29,924	-	-	-	\$21,789	-
Supply	570.00	-	-	2,000	-	-	1,500	-	-	750	-	-	700	-	-	-	350	-
Salary	\$32,500.00	-	-	31,000 (appr.)	-	-	34,000 (appr.)	-	-	36,600 (appr.)	-	-	43,776	-	-	21,900	-	-
Student	246,000.00	-	-	51,600	-	-	50,300	-	-	64,800	-	-	50,000	-	-	17,800	-	-
Total	\$79,000.00	-	-	\$127,367	-	-	\$129,426	-	-	\$112,204	-	-	\$124,100	-	-	\$54,739	-	-
Cost per Circulation	211,000	-	-	216,298	-	-	245,040	-	-	260,024	-	-	304,700	-	-	168,016	-	-
Cost per Loan	374	-	-	584	-	-	524	-	-	544	-	-	104	-	-	384	-	-

Fig. 6. Cost Analysis of a Computerized Circulation System

## Circulation Costs - 1970/71, Main Desk

Salaries	Staff	\$47,350
	Students	18,257
	Student assistants & tempo	<u>2,431</u>
	Total Salaries	\$68,038
Sysdac rental		360
Supplies (tape, ribbons, etc.)		<u>950</u>
	Total costs	<u>69,348</u>
Total Main Desk Circulations		198,902
Cost Per Circulation		28.6¢ each

This cost includes the following procedures;

Circulation

Charging  
 Discharging  
 Placing "holds" and notification  
 Recalling overdues  
 Billing fines and lost books  
 Collecting fines

Stack Maintenance

Reshelving circulating books  
 Reshelving stack-used books  
 Exhibiting new books  
 Shelving new books  
 Reading shelves for accuracy  
 Maintaining faculty studies  
 Maintaining book lockers

Searching

Searching misplaced books

Miscellaneous

Holding duplicate book sales  
 Forwarding orders for lost books  
 Forwarding books for repair and binding  
 Making change for photocopy machines  
 Servicing paper in photocopy machines (nights & weekends)

Fig. 7. Cost Analysis of a Manual Circulation System

From the report of a computerized library operation in Australia which in 1971 had 60,000 volumes in its collection, ten doctoral programs, and was 1,500 miles from the nearest substantial library comes this quote:

#### COSTS

Computer time is free, so the main cost is salaries (approximately \$11,000 Aust.) which is absorbed into the total library budget. [They say "absorbed into the total library budget" as though some magic made the cost disappear.] In addition there is a budget component to cover equipment and stationery costs. In 1971 this was \$2,000, most of which was spent on 1 disk pack (\$600) and DEC Tapes (\$600).<sup>18</sup>

This is the only account of costs of the following current operations: an on-line listing of reserve books, a batch acquisitions system, a batch subject catalog of the collection, an on-line circulation system, and a browsing collection index. How casual can a library afford to be about computer costs in a university library that is running ten Ph.D programs on a junior college collection?

The one good cost analysis that has come in the various replies to my article was from Robert L. Taylor, library systems analyst at the University of Wisconsin at Green Bay, who wrote saying that he agreed with much of what I said, but had a COM catalog production system of great interest. I wrote back asking for cost analyses and got, in two sequential letters the best cost analysis I have seen. Most of the costs are not for computer production, unless you consider the MT/ST a computerized machine.

The first sheet of information (fig. 8) begins where one must begin, with a list of all of the steps in the process of the system. Total costs for cataloging, from acquisitions to shelf, are \$2.35. I was particularly interested in his costs on steps nine to thirteen, card production by MT/ST, and again he sent me an impeccable cost account (fig. 9). Figs. 8 and 9 contain all the components of a cost analysis that are required to compare one system with another, taking into account differences in staff salaries: (1) a complete list of the detailed steps performed; (2) unit costs of each step, over a considerable span of time, backed by statistics of production, and average salaries per hour; (3) a description of all machinery used; and (4) a report of all applicable costs—everything that is required to produce the end product. If we would begin to publish cost analyses in these terms, and with this degree of precision, within a year we would be able to make the best processes visible.

This paper is in a sense my third generation attack on the central problem the computer has presented for libraries, that is, whether the machine is going to do libraries any good. The question has been twisted beyond any recognition by an army of pitchmen, public relations grimmickers, self-servers, and

The processing steps are:

1. Title from acquisitions searched for MF copy.
2. -copy printed - copy placed in book on book truck (100 books on a truck).
3. -typist removes copy and alphabetizes it.
4. -copy is searched in authority and catalog files.
5. -copy in pack and truck of books go to cataloger.
6. -book is cataloged.
7. -call no. put in book.
8. -book goes to labeling then shelf.
9. -catalog copy goes to MT/ST operator.
10. -MT/ST edit copy is produced (28-32 titles per cartridge).
11. -edit copy checked for errors.
12. -edit used in playback to correct tape.
13. -cards are played out and tape is corrected at the same time.
14. -corrected tape is sent for conversion to computer tape (about \$1.50/cartridge)
15. -cards are separated for filing.
16. -computer tape is cleaned and compacted and formatted on a 360/40 system.
17. -records will be sorted by LC call no.
18. -data base will be indexed and run through a computer Output Microfilm unit (COM) to produce an MF catalog of our collection. (We also hope to do this on an interlibrary basis).

Fig. 8. Processing Steps

Input (Items 9, 10)

Typist (2.71/hr. average)	13.100 cents/title
MTST (280/mon. average)	6.500 cents/title
Proof cards (2)	.014 cents/title
Input subtotal	19.614

Edit (Item 11)

Typist (2.69/hr. average)	5.000 cents/title
Input and edit subtotal	24.614 cents/title

Output (Items 12, 13, 15)

Typist (2.25/hr.-operates 2 machines at once)	7.893 cents/title
MTST	6.500 cents/title
Cards (7.2/set average)	0.050 cents/title
Output subtotal	14.443
Input and output and edit total	39.057 cents/title

All figures are based on monthly average title production of 3,020 (for first 9 months of 1971).

Fig. 9. Cost per Title

self-deceivers both outside and inside the library profession. Many library experts recognize this army and are highly critical of its members when I talk with them personally. But public repudiation is never made even though many librarians know they are doing irreparable damage to any sensible consideration of the place of computers in the spectrum of library services.

Michael Barnett, director of research and development at the H. W. Wilson Company, wrote a very good letter in reply to my article,<sup>1</sup> which indicated, among other things, that he had seen far greater horrors in computerization than any I had witnessed: "I have been appalled by the intellectual corruption and the waste of funds that I have seen in ill-conceived and dismally mis-managed automation projects in a variety of fields; and by the drivel that has been promulgated as so-called computer science."<sup>19</sup> And, later:

It is possible for a crew of systems programmers to keep an installation in a state of constant upheaval quite unnecessarily, and in particular without the slightest change of hardware or software by the manufacturer. I have seen computer center staffs force users out of compatibility with other installations in matters that are completely standard for reasons that seem to range from downright incompetence, to an arrogant desire to exert control over other people's work, to regarding the computer as a toy for their personal amusement and a vehicle for practical jokes that verge on the malicious.<sup>19</sup>

Yet when I wrote him asking why you experts did not cleanse your own Augean Stables, he did not reply.

Until the computer is placed in the same condition as every other component in a library—of being considered useless *unless it can be proved otherwise*—until we can look at operational cost analyses with confidence in their validity, until we can see precisely what can be obtained at what costs, we are not going to get very far with the use of computers in library operations.

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## Summary of the Clinic

In this paper I want to indicate the significant elements in the papers and demonstrations given at this clinic and then speculate on some of their implications. The first significant fact is that there have been reports and demonstrations. Examples of successful applications of on-line technology to a variety of jobs which cut across the board of library operations—from acquisitions, cataloging and serials control, through two circulation systems, to the retrieval of biomedical information—have been heard and seen.

Further, each of the contributing groups were able to claim that on-line input and processing produced cost savings or cost benefits over batch processing. Everyone was, in general, happy with their systems.

One or two unresolved, perhaps unattacked, technical problems, did surface during the discussion. One was system size, or perhaps more precisely, file size. Fayollat was asked about expansion of his serials system from 7,000 to 70,000 current titles, and answered that he expected file arrangement and file access to be the critical problem with such an expansion. (Actually, it seems that check-in would be the big bugaboo.) Epstein, in answer to a question in the same vein, said that he would depend on Warheit; that is, he would expect technology to provide the answer. This reply caused some amusement, but Epstein may not be far wrong in his attitude. Certainly thus far history has been on his side. At the 1972 Educom Spring Conference, an account was given of the progress of the development of the first trillion-bit laser memory and the peripheral equipment which must surround it, which is expected to be delivered to the ARPA network shortly. However, how long technology can stay ahead in the game of logical optimum file construction is an open question.

Other technical problems mentioned were transferability, file security, downtime and back-up systems, all of which I will refer to later.

The first, exciting lesson of this clinic is that on-line library automation is now technically feasible. Another aspect of the clinic was provided by its last speaker.

I have been intrigued by an interesting rivalry in innovation among conference organizers, a phenomenon which has manifested itself in strange ways in recent years. It started, to the best of my knowledge, with the Medical Library Association in New Orleans in 1969, with the superb Olympia Jazz and Marching Band, smuggled in under the guise of a lecture entitled "New Orleans Funeral Music—A Dying Art!" The 1970 ASIS Conference at Philadelphia countered with Middle Eastern music, and quite the most beautiful belly dancer I have ever seen for which I am forever in their debt. This clinic, with studied calm, gives us Ellsworth Mason.

Mason is a brilliant performer. His enviable command of language, his elegant turns of phrase, the dismissive wave of the hand, his unrelenting rhetoric, bedazzle and bemuse us to our—and his—loss. For his supporters are hypnotized by the silken glitter of his top hat as he soft shoes his cane-twirling, spats-twinkling, white-spotlit way across the stage. And his opponents, infuriated and goaded, attack the shadow of his cape and not the substance of his argument.

The result of this kind of encounter is a trivial event. Supporters, roaring from the gallery, applaud, unfeelingly and insensitively, at the wrong moments; while the opponents are always one step behind the nimble hooper. Mason's performance at this clinic was no different, and the attempts at rebuttal, with one or two honorable exceptions, fell into the well-laid trap. And the undeniable brilliance of the spectacle obscures the game, more's the pity, for there are real issues at stake.

Mason rather gives the game away in the second sentence of his paper when he says that computerators "do not dare to think about the basic problem which it [the computer] poses to librarianship." There is no evidence that the computer threatens bibliographic procedures or records, indexes or abstracts, reference services, accounting systems, book publishing and the thousand other areas in which it affects the daily activities of librarianship. Indeed, many of our tools could not exist without the computer.

The computer does, however, pose problems to the library administrator who, already burdened with uncertain budgets, staff problems, inadequate buildings and an almost total lack of real planning, is reluctant or unable to introduce one more variable into an already impossible situation. Of *course* someone was going to lash out in sheer frustration. At least it is merciful that the inaccuracies and woeful misconceptions, exaggerated though they be, were presented by Ellsworth Mason with eloquence. The tragic irony is that at precisely the moment when the breakthrough is being made, misguided attack could damage hard won achievements and jeopardize, not further development, but massive implementation and exploitation.



Having said some things which may be disagreeable to Mason, I will now attempt to please him by saying that two parts of his message are absolutely right. These are that new systems have to be cost beneficial, and that group development will probably produce the highest yield from investment.

### Cost Benefit

The new on-line systems must be cost beneficial to the libraries which use them. The central issue facing libraries today is survival. Libraries must move from being a labor-intensive, capital-intensive economic system. For a forceful presentation of this proposition see the papers of the National Commission on Libraries in *Libraries at Large* and Kilgour's article in *American Libraries*.<sup>1</sup>

Four outcomes to the installation of a new system should be considered: (1) a clear financial gain, new vs. old, (2) cost break even, new vs. old, (3) greater expense justified by improved service, and (4) greater expense not justified by improved service. Of the four, the last is clearly unacceptable. An even cost break, (2), is a neutral situation where a decision is governed by personal predilection.

The clear financial gain noted in (1) will presumably override other considerations. (I assume here that the standard of service remains even, if it is not an actual improvement.) Fayollat, for instance, was able to report a clear dollar saving for the UCLA Biomedical Library.

The difficult case is (3), where a greater expense has to be justified by improved service. Both Ohio State University (OSU) and Northwestern University's circulation systems reported dramatic increases in the number of transactions—31 percent at Northwestern; and OSU reported that its costs are now even with what they were before it installed the system; nonetheless its circulation has increased over 40 percent. Much of this increased service occurred before recent budget changes increased costs to their present even point.

Cost benefit analysis in libraries is almost nonexistent. Libraries have lagged behind management and industry in developing methods for assigning value to the benefits of improved service. I was told the other day of a cost benefit study which concerned the search for a power station site. One of the sites under consideration would have affected an existing ski slope and resort area. The cost benefit analysis attempted to account for any interference with the skiing by measuring such factors as the amount of play time spent on the slope by skiers, the investment in equipment by skiers, the investment in equipment by ski slope developers, and the value to the community of the availability of the skiing facility. The outcome of that cost benefit analysis is not important for this discussion. What is important is the fact that the planning authority was prepared for, and felt that it had the tools to perform, such an analysis.

All of the systems reported at this clinic claim some extra benefit, such as improved control, better management information, and so on. The most unexpected claim was Miller and Hodges' report that an overwhelming benefit was the development of a team planning attitude in the total organization. Clearly, this last is an enormous benefit, and it should be possible to place a dollar value on the benefit as decisionmaking within the organization improves.

In general, however, we in libraries do not know how to measure the cost benefit of improved service. I submit that we have to develop some understanding of the problem as we encounter increased competition for dwindling resources. We should be able to face management with confidence in our own calculations when we seek funds. When Atkinson was asked if his budget and credibility had increased as a result of the system, he answered, "credibility, yes; budget, no." He surely is heading in the right direction though.

### Modes of Implementation

There are a number of ways in which libraries can acquire the benefits of on-line service. They can develop it themselves; they can participate in joint development; they can link into an existing development which is capable of and prepared to accept expansion; or finally, they may be able to exploit existing facilities to their particular advantage.

Let us take the last case first. There is a small library situated on a large research reservation which found available an elegant package of text processing and retrieval programs maintained for the on-line access of its own research community by a central computing facility. By utilizing this package the library was, within a few days and at no capital cost to itself, able to develop a library system in which current acquisitions from all sources were entered onto the file via terminals, and a variety of outputs were produced, including catalog cards, announcement lists and KWIC indexes. The system has the capability of expanding into an abstracting service, with Boolean text search facility, whenever the library feels that it is able to take advantage of these modules. The cost to the library is maintenance cost only. It is clear that, as on-line networks develop, more libraries can exploit such situations *if* they are alert to the possibilities which present themselves.

One approach is to develop the system for one's own library. There have been accounts of different attacks on this problem during this clinic. Miller and Hodges discussed their adoption of the IBM package FASTER; Auld and Baker reported on a computer system which developed its own operating system. Atkinson contracted IBM to do the job. I do want to draw attention to a statement by Auld in which he warned that locally developed software is a major undertaking, particularly if it means playing with operating systems. As the number of networks increases and our understanding of networks improves, the unique library-developed on-line system will become the rarest example of on-line development.

The next case to be considered is that of the library or consortium which links into an on-line system which is capable of expansion. Pizer presented a map of the Biomedical Communication Network (BCN) and told about the growth of the National Library of Medicine's Medline system.

The Five Associated University Libraries (FAUL) and the New England Library Information Network (NELINET) are two consortia which have been fortunate in being able to pursue this course of action. Both FAUL and NELINET are presently negotiating agreements under which they will link into the Ohio College Library Center (OCLC) system by the direct terminal hookup of their member libraries. This is seen to be an interim step prior to planning the eventual replication of the OCLC system in their respective regions and the direct linkage of three major computers. The advantages of this kind of arrangement are obvious. In the short term, the incoming consortia will avoid the heavy development cost of building the system themselves, and yet their usage of the system will significantly reduce costs for the original members. The long-term advantage is even more important.

I believe we are witnessing the birth of a national on-line bibliographic network, particularly since it seems possible that the system may expand beyond OCLC, FAUL or NELINET. The prospect of, for example, Ohio State University, Yale, Cornell, University of Pennsylvania, and Dartmouth sharing and contributing to the same MARC data base is exciting, to say the least. A similar growth situation is taking place at Stanford as Epstein and Veaner related.

The characteristic which underlies the expansion of these systems is that it is possible to demonstrate the potential for clear cost savings. Both FAUL and NELINET performed internal feasibility studies before making their decision to seek formal relationship with OCLC. The published cost studies on the expansion of the Stanford BALLOTS system network performed by Eleanor Montague are a model of their kind.<sup>2</sup>

Finally, in modes of implementation, we have to look at the joint development of on-line systems. Probably the most successful example of joint support for such a development is the OCLC system. The Ohio College Library Center has been running its on-line shared catalog service, including the submission of original records in MARC II format by member libraries to the central data base for the common good, for a year. The sharing of costs and expertise in a successful system development project is clearly very attractive to the participants in such a venture.

### Consortia

The present economic situation points to the joint development of such systems. Library consortia can provide both the necessary financial base and an adequate resource of expertise, but the development of a consortium is not

an easy undertaking. The human problems which can be encountered must not be underestimated. The consortium must have a clear mission, and objectives which are understood and accepted by all. Program priorities must be assigned which will certainly not suit every participant. The consortium members need to have patience and courage; results cannot be expected overnight, while uninformed criticism comes easy. The difficulties must be assessed realistically and adequate funds provided.

We have to face the fact that no one library is strong enough to do this alone and we must be prepared to work cooperatively. Institutional pride is vital to any organization, but common sense must prevail and a reluctance to seek and exploit any opportunities to better serve one's institution is a disservice to it. Enlightened institutional awareness is better than misplaced institutional loyalty.

### Standardization

Pizer devoted a section of his paper to standardization—a concern which immediately emerges when considering cooperative on-line library technology. Standards apply in a variety of forms—standard data, standard formats, standard outputs, and standards of service—and are essential if systems are to be transferred or replicated.

A standard format is an absolute necessity for the interchange of data. Libraries are indebted to the Library of Congress for the MARC formats and the distribution of data in that format. Standard data is harder for librarians to accept, wedded as they are to old practices and traditions. I am impressed that OCLC, when faced with either forcing total acceptance of data or facilitating easy modification of data through an on-line system by its members, chose the latter course. Some essential changes do have to be made to records before they may be accepted locally. As Kilgour states, "Uniformity [is] a requirement by which libraries have never been able to abide. . . . Uniformity and standardization are not synonymous."<sup>3</sup>

At the same time we have to recognize that making such changes costs money. Careful thought should be given to the question of which elements in a record should be changed, and what will be the real effect of such changes on the library operation. For example, a recent internal study performed at the University of Rochester examined the effect of total acceptance of LC class numbers on shelving.<sup>4</sup> It was found that 61 percent of books would be shelved in the same place, 13.5 percent would be between one and three places off and 20 percent more than three places off. A subsequent smaller study on the final 20 percent showed that (in class N) 70 percent would be within twenty places, or on the same shelf. In other words, (with the exception of classes P and Z) acceptance of an external data source might not be as damaging on reflection as it seems at first.

This brings us to internal standards of service vis-à-vis on-line cooperative systems. David Kaser stated the problem clearly when he wrote "Some [libraries] would in certain operations have to raise their individual standards to those adopted by the group, and that costs money. In other operations some would have to settle for lower standards, and that is expensive in its impact upon institutional pride, dignity, and morale."<sup>5</sup> Librarians will have to face a complete reexamination of their standards for both records and services. The new technology presents this opportunity since things undreamed of by our predecessors can now be done as we realize that many articles of professional faith are really statements of temporal expediency.

### Finance

I remarked earlier that we are entering a phase of massive implementation. The difference between possible and feasible is precisely the difference between an intriguing research task and a successful, attractively priced system. A number of the systems reported on at this clinic clearly fall into the latter group, but their consolidation and expansion demand a high level of capitalization.

What are funds needed for? We will need to run the systems for some time, perhaps two or three years, before we can claim anything like maximum savings, or before they break into a cost-benefit mode. Meanwhile, terminals have to be bought, computers and telephone lines leased, operating staff hired and changes made in existing procedures, all of which costs money. Federal agencies, state and local governments, grant foundations, and parent institutions should be prepared to support this revolution in technique.

Librarians as managers of their systems should have as much confidence in their requests for capital and their ability to deliver on investment funds as they as individuals have when they approach a bank manager for a mortgage. Of course this may present difficult problems in the internal accounting structure of many organizations but such a condition should not act as a deterrent to change. Requests also presuppose efficient cost-benefit analysis.

There is one other significant area in which federal funding in particular should play a major role, and that is in the development of major data bases. For instance, it is, to put it mildly, a disappointment that there is still no major machine-readable data base of standard serials catalog data, particularly since the absence of such a resource will clearly retard the development of on-line serials control systems. Such data bases should be created as expeditiously as is possible.

While discussing finance I want to refer to one of the recurring questions which appeared all through the clinic—the problem of downtime and back-up systems. It is important that we realize that these problems are, in general, of financial rather than technical origin. We just cannot afford to run a second

complete computer and communication system as back-up to the first so that it automatically kicks in when something goes wrong. To use a simple analogy, it would be like towing around a second car in case the first breaks down. Only space flight can afford that kind of technical duplication—and perhaps only space flight needs it. Rather, we have to do the best we can to prevent failure by good system design, and to minimize the effects of failure when it does occur by protecting files and data.

## People

Before we get started with the available technology, the human aspect of the task must be considered. First, as librarians try to convince administrations both inside and outside libraries that they deserve financial support, they also must convince their professional colleagues. Libraries are facing problems. One reasonable solution to some of the problems is on-line computer technology. Librarians are reasonable people and are prepared to accept reasonable solutions. (I use the word reasonable to mean based on "reason" or "sound thought and judgment," rather than merely tolerable or acceptable.) They have a responsibility to present the answers in such a way that they can be understood by the profession. They should not shrug this off as an unworthy exercise, since the failure fully to understand the new technology will surely wreck our efforts. If clarity of thought and felicity of expression can prevent sabotage of systems, librarians should seek them.

Second, librarians have to recognize that cost savings will come largely from the personnel budget, which presents a human problem. After 150 years of industrial revolution librarians should know enough to be able to solve the problems of staff retraining and reallocation with humanity and patience. Decisions on how to achieve the essential savings will be necessary, and I hope that normal attrition is a strong enough tool. I do not believe that librarians are Luddites who will destroy machinery. Librarians must consciously decide that the necessary changes will be implemented with compassion; on the other hand, as a profession we cannot respond with blind, unreasonable opposition to measures which will save libraries.

There is a logical alternative to clumsy staff reduction, and that is not less but more librarianship. For example, the present bibliographic description is at best a poor tool which librarians should be prepared to augment and enhance with analytics and better subject description. The art of subject bibliography barely survives since so much of our time is taken with routine procedures. But this alternative requires that funds realized by savings made through the enlightened use of technology be used to enhance the services offered to the user, an action which must be presented to the administrator with cogent argument and firm cost-benefit projections.

## Total System Service

Finally, I want to look at the future which Warheit denied himself in the excellent paper which opened this clinic. In the papers which have been presented there are some clues as to the final shape of the on-line systems which will be used by libraries. I believe that we will eventually see, in the center, an arrangement of very precise task-oriented files, made up of very short records of carefully selected data elements being used to perform the housekeeping functions of circulation, acquisition, fiscal control, serials control and, probably, the shelflist. Surrounding and supporting these will be the major standard, almost static (once a record is established) files of full bibliographic description which will support and supply the volatile task files. Further out will be the files of indexes and abstracts which will be searched either currently for selective discrimination of information or retrospectively for or by the library users, and which will also link into the center files to provide location and availability information, and, perhaps rarely, to the middle circle for bibliographic data.

The remarks made by Atkinson on the feeding of the OSU on-line shelflist for circulation purposes by OCLC tapes and the way in which BALLOTS is expected to develop, clearly point in this direction. Pizer's account of the proposed interlibrary loan module of BCN attacked the problem from the other direction. The work being done at Syracuse University, not reported at this clinic, also points this way.

I have talked throughout this summary of funding for implementation, but the research is not yet over. Rather, it may soon be moving into a phase of synthesis as the discrete building blocks are joined into a comprehensive system, and the need for adequate funding for research is just as urgent. But I believe that the systems which are presently available and the quality of achievement which they represent should give librarians confidence as they seek support.

On-line library systems have moved from being technically possible to being technically feasible, as we have seen demonstrated both at this clinic and by other workers in the field. If we can continue in this direction we can develop a total system of service which is aimed at a vastly improved individual service for the user and an efficient operation for the library.

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